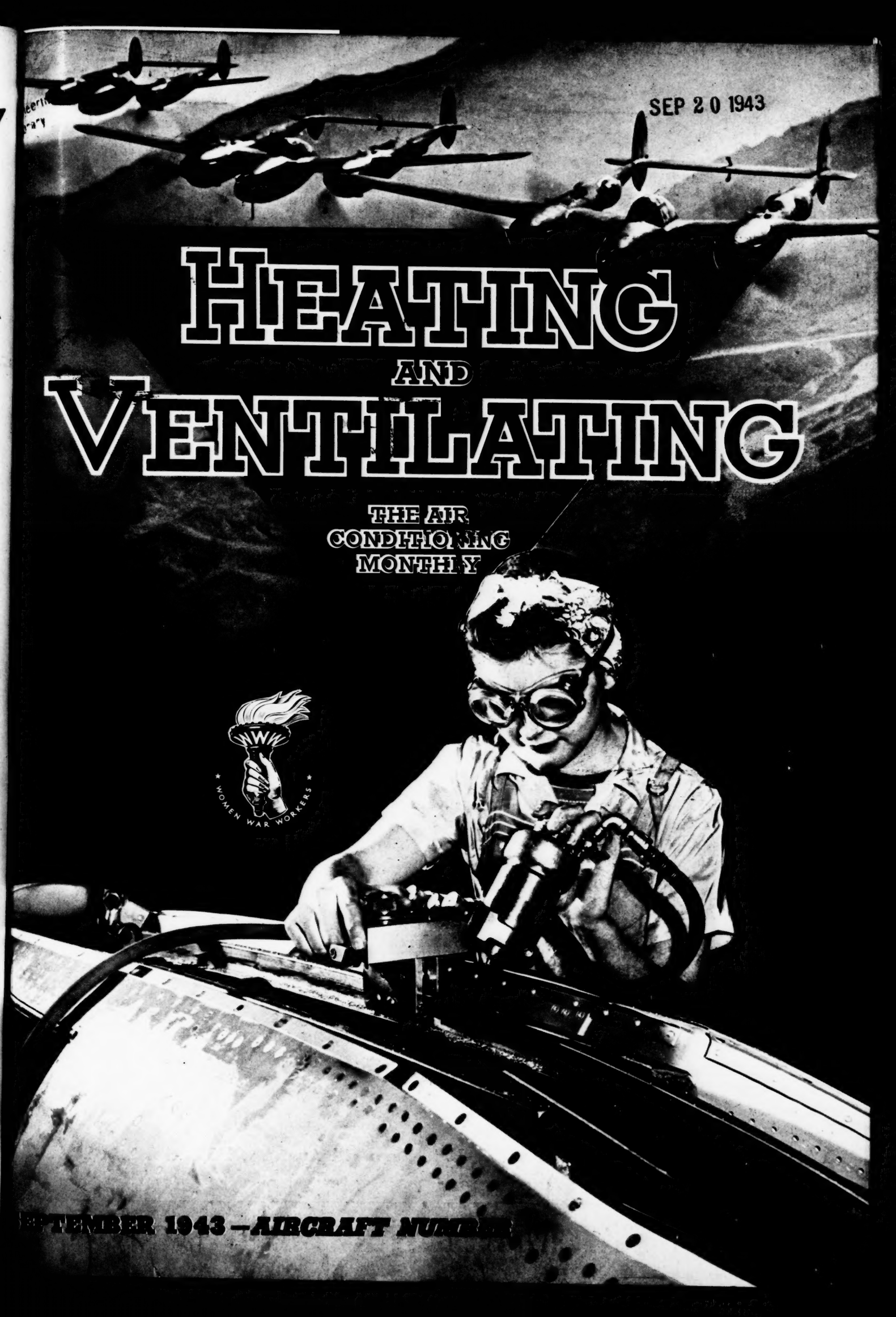
SEP 20 1943

HEATING AND VENTILATING

THE AIR CONDITIONING MONTHLY



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HEATING AND VENTILATING

The Air Conditioning Monthly

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THIS ISSUE : ONE DOLLAR

THIS MONTH'S COVER

is dedicated to the Women War Workers of America and shows mechanette Vera Lowe driving a high-speed air driven router which trues up the nose of the Lockheed Lightning P-38.

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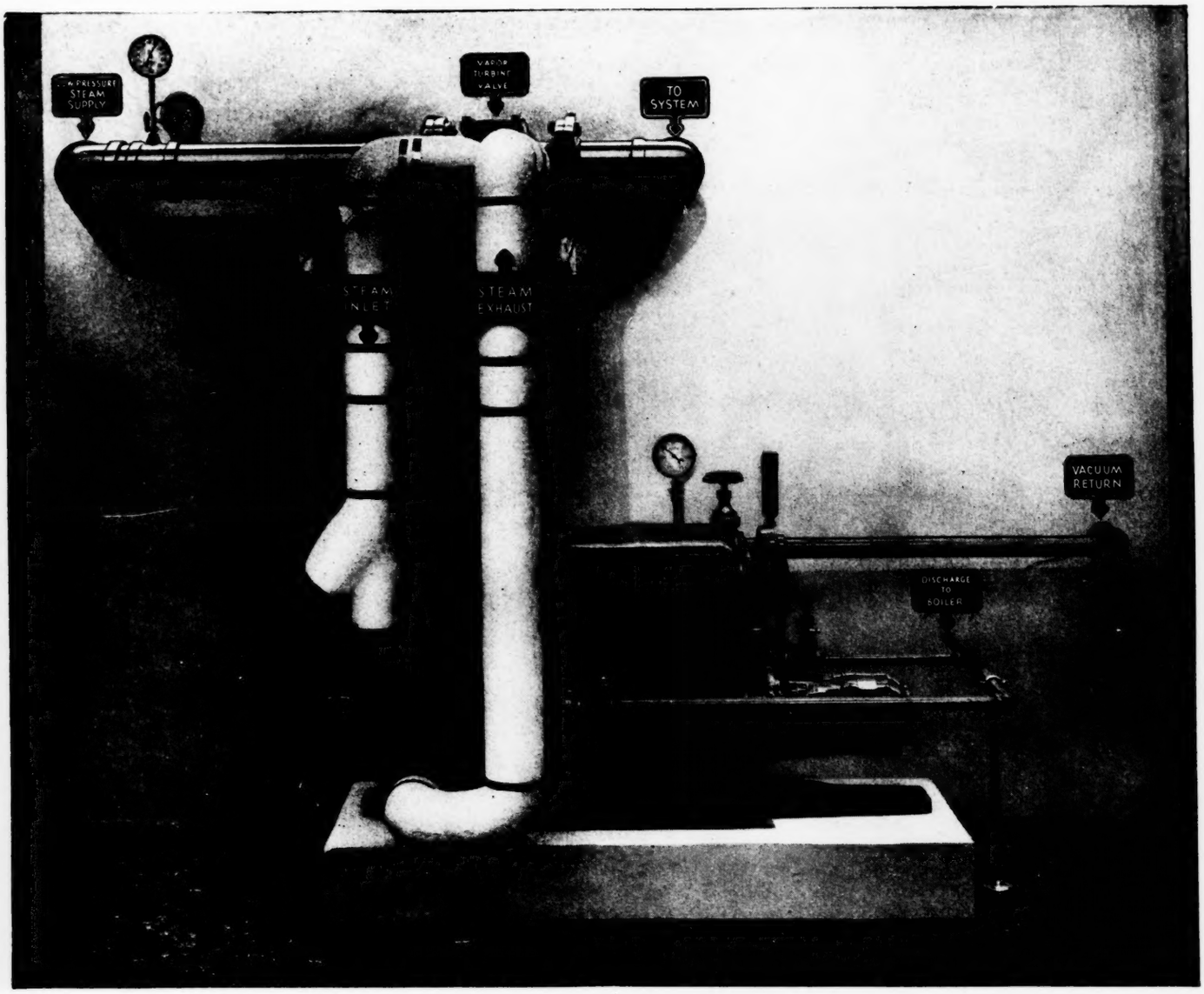
Interrupted Electric Service will not stop this NASH Heating Pump!



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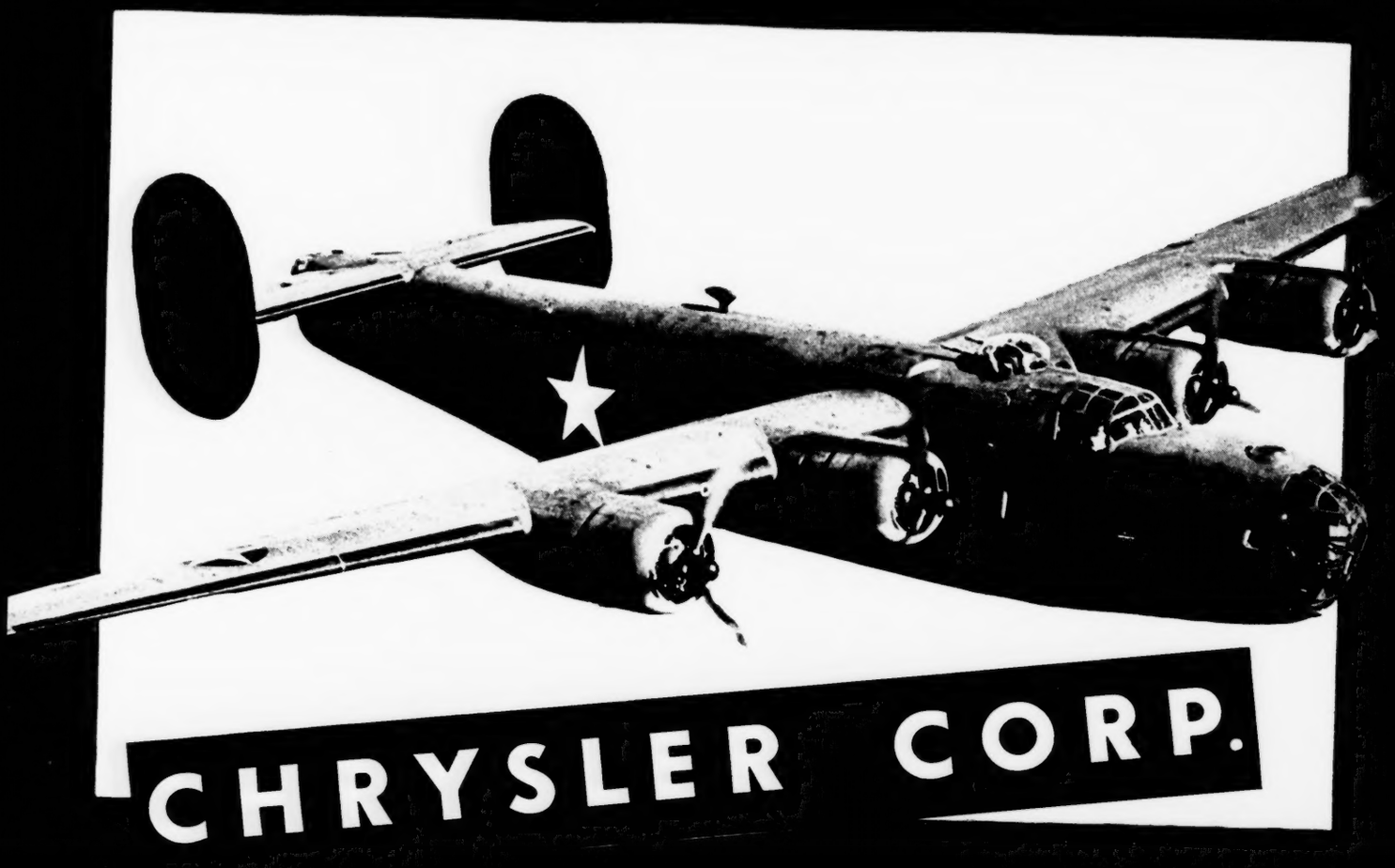

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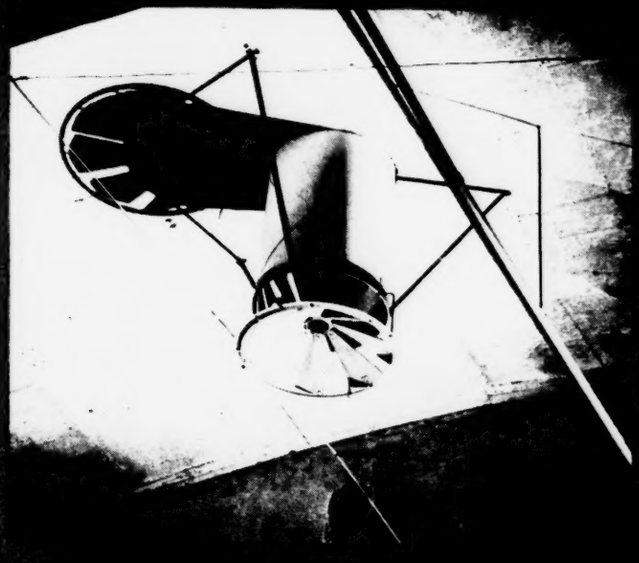

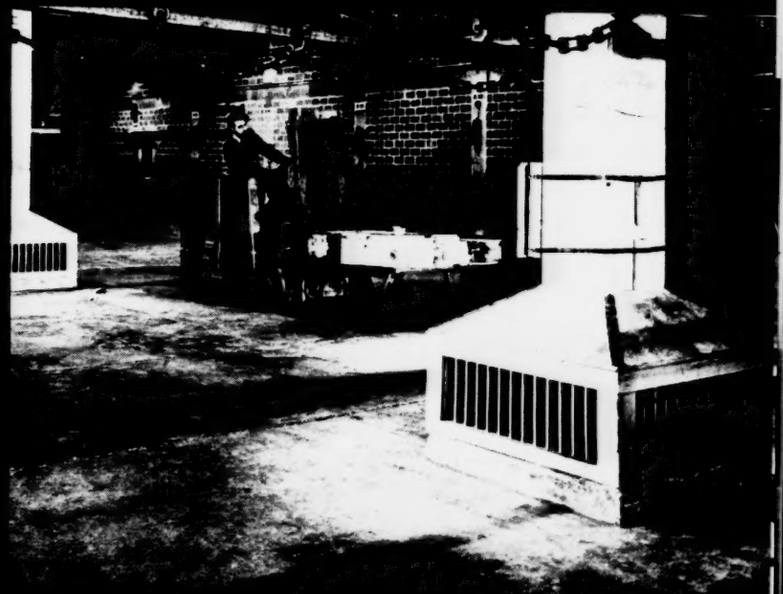

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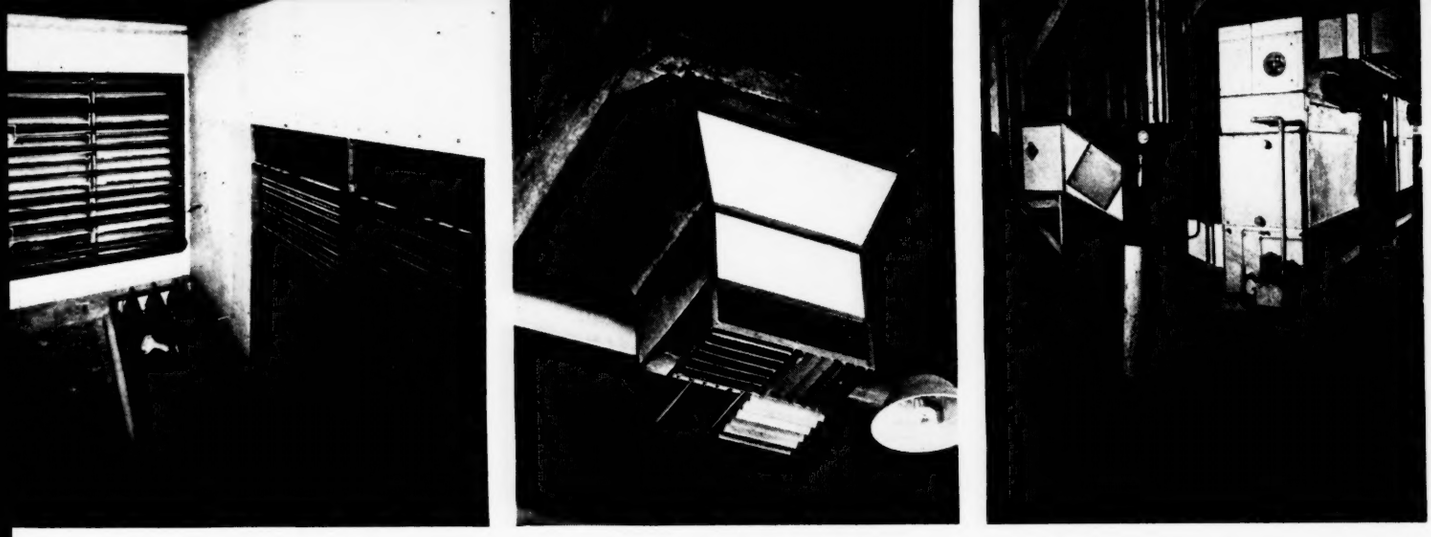
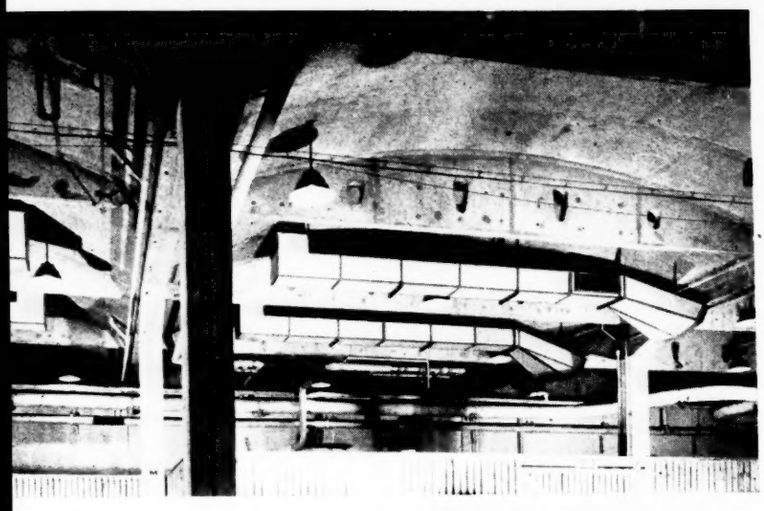


(Left) View inside the mixing chamber of air conditioning equipment. Automatic filters are at right, automatic fresh air dampers in the background and recirculating dampers in the foreground. The dampers are operated by air motors. (Center) Typical blackout type of ventilating unit used for bringing in outside air. An even diffusion pattern is secured by setting the grille blades at the proper angle. (Right) Two of the evaporative condensers. In the foreground at the left, a part of one of the refrigeration compressors can be seen.



Typical group of four drops and duct laterals with side outlets and end diffusers, which supply conditioned air to about a third of the assembly building. Each assembly of equipment as illustrated handles one of these duct groups. A large steam line expansion loop is seen at the lower right.

steam is used twice before being returned to the boilers.

The building itself is heated by hot blast systems with overhead unit heaters at the doors and along the side walls, loading docks, etc. One-third of the building, which is the assembly area, is also air conditioned the year round. The type of heating system (namely the hot air) was decided upon due to the tremendous area of the building—over 80 acres—without any windows or skylights except in the side walls. This meant a very extensive air movement with considerable quantities of fresh air to insure the best working conditions.

In the main area exclusive of the Heat Treat Department there are several score of large fan rooms on the roof, each having a large capacity, which is all fresh air in the summertime, but enough air is recirculated in the winter to bring the intake air chamber temperature up to 50F before passing through the coils which have enough capacity to raise the outlet temperature to 90F.

The total air supplied to this area totals millions of cubic feet per minute with enough outside air make-up in the winter to keep the entire area fresh for ideal working conditions. This excess air introduced was removed by two methods: first by process exhaust and the remainder by a system of exhaust ventilators installed at certain intervals on the roof. These units are of the blackout type, complete with non-metallic hoods, fans, motors, shut-off dampers, starters, etc. There is a total of some several hundred of these units, and they are operated by the push button starters (which are within reach of the floor) when or as required, depending on how much fresh air is introduced into the area.

The unit heaters in the Truck Wells are all controlled by thermostats and three position starters which allow them to be run in the summer for air movement without disconnecting the thermostat.

The final assembly area which is air conditioned covers about one-third of the building and required this constant temperature to insure the various parts being inspected and assembled do not have too great a variation in expansion and contraction, which would be the case if this area did not have controlled temperature. There are nine fan rooms on the roof, each one of which is long enough to house nine supply fans and 60-ton individual Airtemp compressors together with evaporative condensers.

The ducts are under the roof in this area and hang as close to under side of the beams as possible These ducts are all fabricated out of Transite sheets and put together with metal corners held in place by screws with each joint sealed tight. When these metal corners are painted a battleship grey they make a very effective appearance as well as do a very serviceable job of air distribution.

This area also has a certain amount of roof exhaust units though a maximum of 25% of fresh air is introduced at any time

Before deciding the type of refrigerating units to use in this area the various types were considered, including the central system with chilled water lines to each unit. The system selected, namely the Airtemp individual units, was finally decided upon for various

good reasons, chief of which was the fact that they would be obtained much quicker than the large central unit, and they could be installed in the fan rooms without any additional building requirements.

There is a very large basement area which is devoted to locker rooms, lunch rooms, cafeterias, kitchens, etc., which are all 100% ventilated from large fan rooms in this area. A large portion (approximately 75%) of the air supplied to these areas exclusive of the kitchen was able to be recirculated through the use of activated charcoal filters for removing the odors. Without these units all the air handled would have to be fresh air as odors are very objectionable from these areas under normal circumstances.

Use of these odor removing filters also saved considerable amounts of steam which in turn reflects on the fuel consumption, and enough fuel was saved to amortize the cost of these units in three to four years.

The kitchen required to feed the tremendous numbers of workers in the plant required a 6 in. 30 lb steam line to handle all the kettles and steamers at full load, which gives some idea of the size of this building and the number of people served.

All the condensate returns from the various unit heaters, blast coils in the basement and roof fan rooms, the process equipment, and kitchen run to pump and receiver units located in carefully selected places in the buildings. There are five of these units serving the first floor requirements and four in the basement fan rooms for these rooms and kitchen equipment. These units are all of the duplex type equipped with two float switches in the tank actuating the pumps through starters and an alternator. This alternator is so arranged that the low float starts first one pump and then the other with the upper float always acting as a standby on the other unit. This system keeps *both* pumps in running condition at all times. The discharges from these pumps connect to the main pump discharge line which connects to the main receiver in the Boiler House.

Tool Shop

This building houses the skilled mechanics who make the cutting tools, jigs and fixtures used throughout the plant, and it has no special requirements other than the heating system. The steam and pump discharge lines serving this building are run underground in conduit from the Assembly Building and enter the Tool Shop from a pit in the corner. The steam pressure is reduced at this point from 150 lb per sq in. to 30 lb per sq in. through a pressure reducing valve station before being distributed to the heating system.

This system consists of overhead vertical heaters in the main working areas, blower-type heaters for blanketing the doors and propeller or disc type units in the toilet rooms. All the returns from these unit heaters run by gravity to the duplex pump and receiver unit which is centrally located before being discharged back to the Boiler House through the grid system.

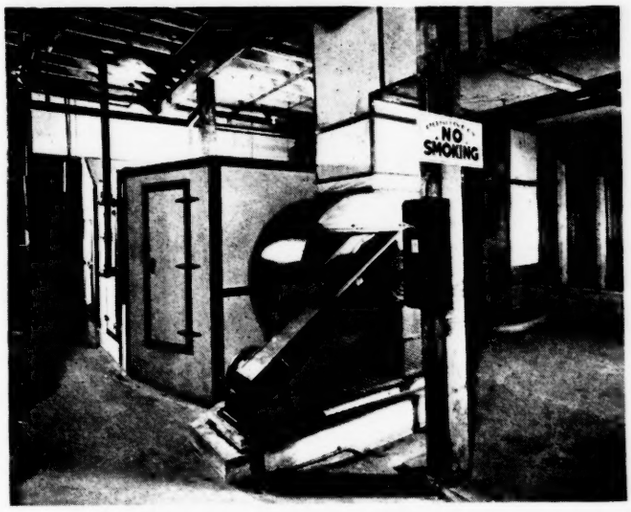
There are some exhaust ventilators on the roof similar in construction to those in the Main Building —also two fresh air supply units which are equipped with non-freeze steam coils, face and by-pass dampers and starter and thermostat for controlling the face and by-pass dampers.

It is possible to keep a reasonably good fresh air supply coming into the building at all times, both summer and winter, with these units, which makes for very excellent working conditions and maximum production.

Incidentally, this building was one of the first ones completed in order to get as many tools ready as possible for the remainder of the plant as needed. A small portable boiler was installed as close to this building as possible and a temporary line connected to the permanent heating system within the building which kept this building in operation for many weeks before the Main Boiler House was completed.

Office Building

This building which is of two story construction



(Left) Typical view inside air conditioning equipment penthouse on roof of main building. Each conditioning group consists of mixing and filter chamber, cooling coils, heating coils, fan, motor, and asbestos-cement ducts and drops. The refrigeration compressor and evaporative condenser, also included, are not shown. (Right) Another view of asbestos-cement air conditioning ducts and steam line expansion loop.

houses all the office staff as well as part of the laboratory technicians. The building itself is divided into two sections, one of which is for the factory office staff. The basic reason for designing and building these two units so long and narrow was to allow all rooms to have outside windows and natural ventilation, as the WPB ruled that no mechanical ventilation would be allowed for these buildings.

The heating system itself is of the two pipe gravity steam type with the supply and return risers feeding up to the radiators from the mains which run around the building below the first floor in a 4 ft sq trench. The steam service is brought into the building at 30 lb pressure and is reduced to 4 lb pressure through two pressure reducing valve stations.

The heating system for each of the two buildings is divided into four sections in such a manner that the portions in shadow are on separate zones from those in the full rays of the sun. These zones are controlled by thermostatic valves and room stats located in the larger room areas rather than in a private or small office.

The radiation itself is of the thin tube cast iron type with legs. The connectors to these radiators are all from below, from the trench to the first floor radiators and on the first floor ceiling between the radiators and risers.

Personnel Building

This building is of one story construction and is heated in essentially the same manner as the Office Building with some small ventilating units added for the examination rooms and waiting rooms. Also there are some first-aid units in the building which have various pieces of equipment requiring medium pressure steam all the year around. This is accomplished by running a separate line from the 30 lb steam service to this equipment which can be operated independently from the heating system whenever required.

Test Cells

This building houses some of the most important functions of this whole plant and per unit volume of building likely has more different kinds of piping than any other building in the plant. This building is where all the engines manufactured are given very exhaustive tests under actual running conditions.

There are many varied problems to solve in a building of this type not only in the heating and ventilating trades but also the plumbing and electrical. There are the various cooling lines to distribute to the engines, the fuel oil, all the different types of gasoline, and so on which makes this building a nest of pipes.

There are a certain number of test cells and control rooms in which the operators sit before their instrument panels which control all services to the engine being tested. All the oil piping, cooling water and gasoline serving this engine are piped through this control panel. The fans supplying hot or cold air to the carburetors are also controlled from this same panel.

Each control room is completely ventilated at all times as well as air conditioned in the summer.

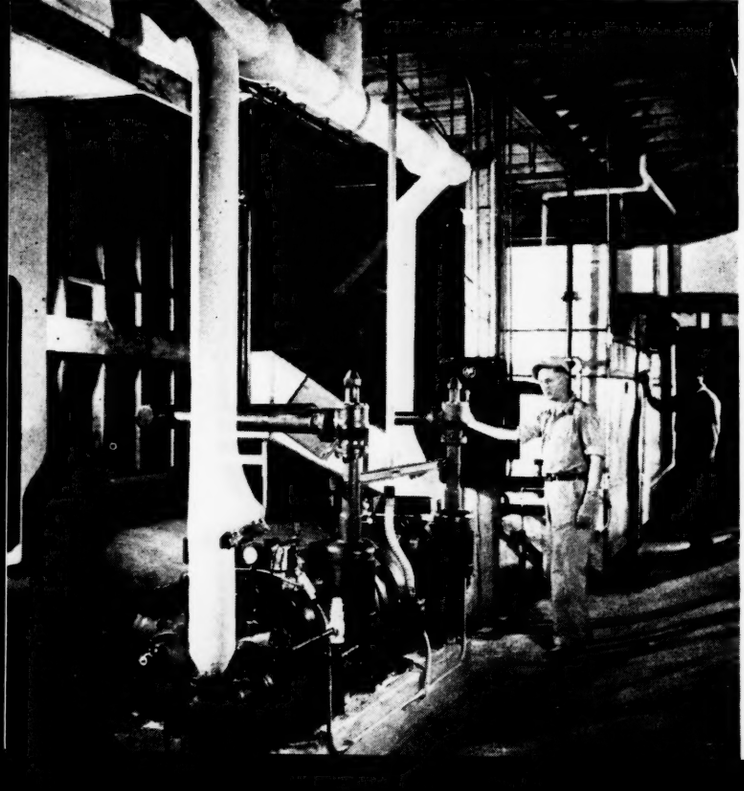
Large quantities of outside air are introduced into the power absorption room where the dynamometers are located in order to keep this room at a reasonable temperature.

When this building is operating at top speed in the wintertime and all these various fans are operating there is a very considerable quantity of steam required to temper this air. The steam is supplied to these blast coils at 30 lb pressure, and these lines are either controlled by a duct stat or a room stat depending upon their use. The returns run by gravity to pump and receiver units in the basement fan rooms before being discharged back to the main grid system.

There are some unit heaters of the projection type in corridors, at the large doors and toilet rooms, all supplied from the same lines as the blast coils and controlled the same as the Main Building.

Magnesium Foundry

The problem in this building was primarily one of introducing enough fresh, cool air to replace the process exhaust in foundry area, blanketing the large



doors and heating the shipping and receiving areas with unit heaters. There is also an office and locker room area along the side of the building which is two stories and heated by direct radiation with some ventilation for the locker and lunch room areas.

Aluminum Foundry

This building is almost a duplicate of the Magnesium Foundry and is treated in the same way as far as heating and ventilating is concerned.

Light Forge Building

This building is in the second group of buildings together with the Heavy Forge and Heat Treat & Die Building, and they are all supplied from the small Boiler House.

This building is long and narrow and is inclined to be hot due to the large number of furnaces required to supply the hammers with hot forgings. For this reason the building has a great number of doors on three sides which can be opened up wide, weather permitting. However, in cold weather these doors must remain closed so a fairly large quantity of fresh cool air has to be introduced into the building. The only air exhausted from this building is that required for combustion so the exhaust is a minor quantity.

This air is introduced into the building through louvers in the side walls which are connected to the intakes of large suspended type unit heaters equipped with centrifugal fans. These heaters are suspended from the under side of the cranerails in an inverted position which brings the discharge outlets approximately 20 ft above the floor. These outlets discharge almost straight down in order to get this cool air as near the floor as possible and underneath the hot air issuing from the furnaces.

When the fan motor is started and the transfer switch set at "fresh air" the recirculating damper remains closed and the fresh air damper opens wide to permit 100% fresh air, while if the switch is set at "receiving air" the recirculating damper remains closed and the receiver damper is open 100%. This receiver arrangement is only used to keep heat in the building if the plant is shut down or for possible Sundays of non use. The temperature of the air is governed by the face and by-pass dampers controlled by a duct stat.

Heavy Forge Shop

This building is almost identical with the Light Forge Shop and is heated in the same manner.

Heat Treat and Die Building

This building houses some of the equipment on which were to be made some of the earliest tools required for this plant; so this was one of the first buildings finished and heated from a temporary boiler mounted on a concrete slab outside in the open.

The building is divided roughly into two parts with a two story mezzanine in between and a two story office portion at the extreme end of the Die section.

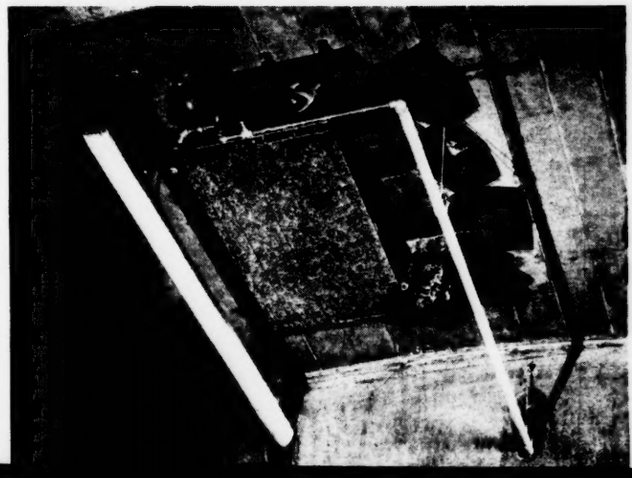
Steam is brought to this building through a tunnel at 10 lb back pressure, and all the radiators, unit heaters, fresh air supply units, etc., are operated at this pressure.

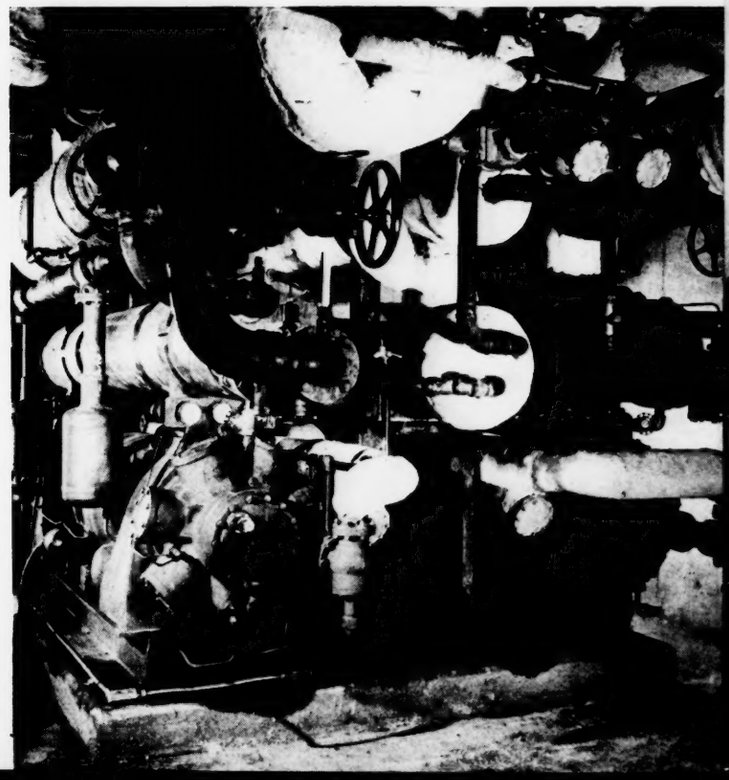
The office section is heated by a two pipe gravity steam system in the same manner as the Office Building. The two story mezzanine section is heated by direct cast iron radiation in the offices and laboratories and with projection type unit heaters in the lockers and lunch rooms.

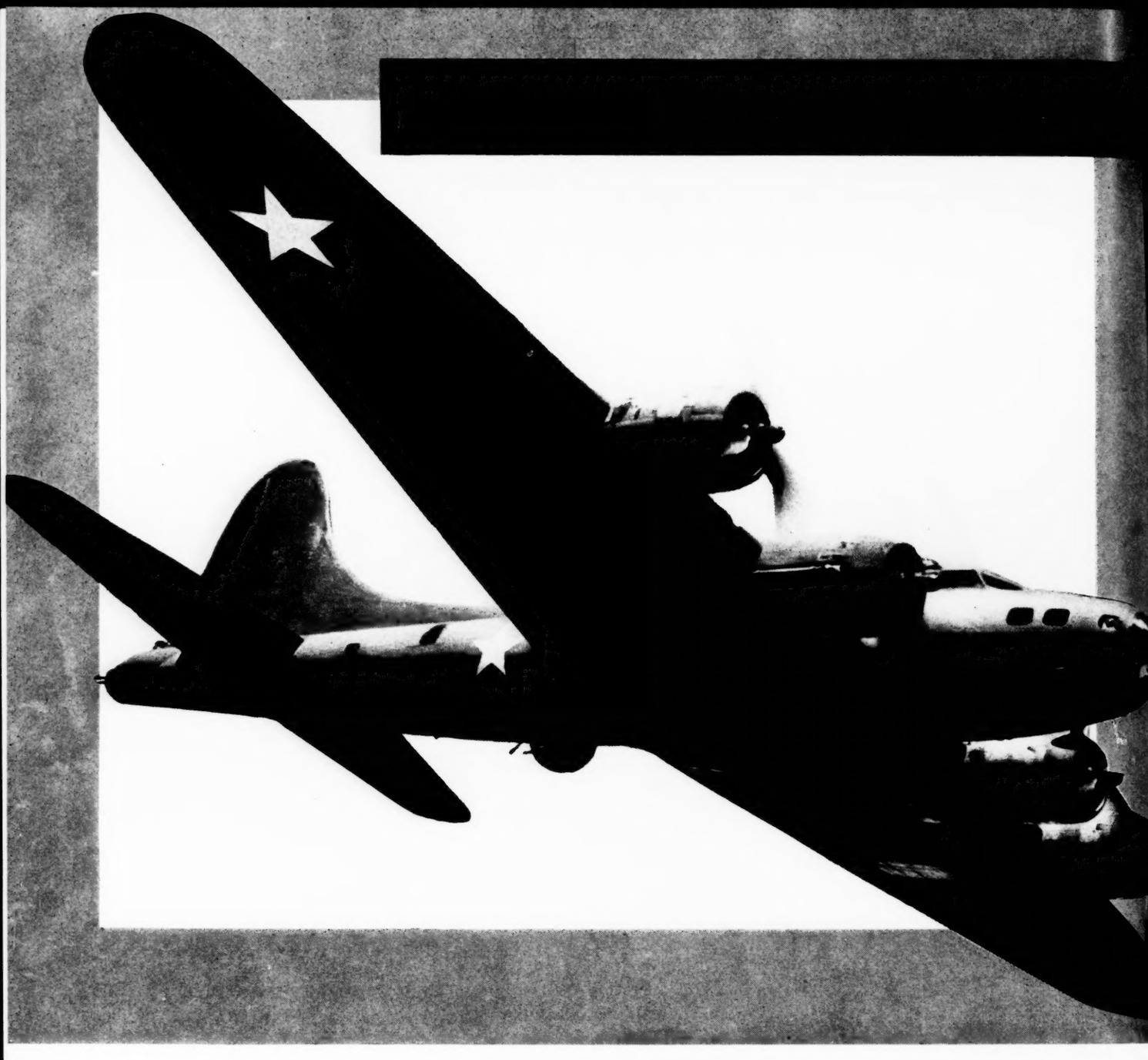
The Die section is heated by projection type unit heaters with suspended type blower units at the doors controlled by door switches and stats. There are roof ventilators for supplying fresh air in the summer and exhaust ventilators for exhausting the stale air. There is also enough of the summer supply units supplied with steam coils to supply one complete air change per hour the full height of the building in this area.

The Heat Treat presented two main problems, one of which was to move enough air to keep the temperature of the building within proper limits in the summer and the other to heat the building when necessary.

There are winter supply units on the roof for winter operation.







plant for aircraft part gear assemblies has air conditioned gauge room, ventilation for various areas, and 12 boilers for heating.

By DAN ADAMS
Chief Mechanical Engineer
Lockwood Greene Engineers, Inc.

THE blackout plant for the manufacture of aircraft parts built by Defense Plant Corporation in 1942 and operated by General Electric Company in Bloomfield, N. J., presented some interesting heating, ventilating and air conditioning problems.

A general view of the development is shown in Fig. 1. The shop proper is a one story structure of wood and brick with bays 20 ft × 50 ft. Wood trusses of the bow-string type support a 4 in. laminated roof. All of the floor area can be served by traveling cranes. This shop was required to be entirely light-proof for blackout. Windows were placed in the side walls, not for working light, but to enable the operators to see out and for additional summer ventilation. These, however, were glazed with transite to maintain the blackout feature, with the idea of reglazing the glass after the war. Along one side of the shop is a one story service wing cut into rooms

for cafeteria, kitchen, sandblasting, plating, toilets, boilers, supplies and garage. Above this wing are two fan rooms. Across one end of the plant is a two story office building.

This plant machines gear assemblies for aircraft equipment. All machining must be done within extremely close limits of tolerance. The heat load in hot weather is approximately 4,000,000 Btu an hour. Careful consideration was given to air conditioning to maintain uniform temperature throughout the year to assist in holding the machine operations within the required tolerance. In order to save critical materials, the final decision was to dispense with air-conditioning and to handle the temperature problem by adequate ventilation with provisions in the design of the system for the future installation of cooling equipment. However, the gauge room where precision measurements are made was air-conditioned to maintain uniform temperature in this department at all times.

The air supply system for ventilation was based upon two large central supply units instead of a multiple unit installation, primarily to facilitate the filtration of all supply and return air. Freedom from atmospheric dust was considered essential for these precision operations. A blackout plant, especially in the absence of artificial cooling, presents a problem in supplying sufficient air capacity to avoid excess temperature variations in hot weather without creating so much local air movement that the operators will object. This installation has been successful on both counts. Initially there were some complaints from operators based upon excess air movement, but it was possible to remove all such complaints by damper adjustment. The shop operation in summer is very satisfactory, and better than predicted. One reason is that the whole shop temperature is reduced by circulating the full air quantity during the cool night hours. The principal reason is that the supply air is introduced below the level of the lights, and the exhaust air is removed from the peaks of the roof. Thus, heat from the lights and from the sun load on the roof is removed directly, and full advantage is taken of stratification. The room temperature in the lower 8 ft is substantially below the temperature of the air exhausted. The amount of outside air supplied in hot weather is 150,000 cfm, which is approximately seven changes per hour.

Automatic controls proportion the amount of outside air from a maximum of the full fan capacity in hot weather to zero in cold weather when the shop is not in operation. During operating hours in cold weather enough outside air is taken (1) for minimum ventilation, which is estimated at about 30,000 cfm, and (2) to balance the internal heat load. Even in zero weather the air introduced is slightly below room temperature so that the supply system operates at all times, except during shut-down periods, on a cooling cycle.

The temperature of the supply air is adjusted to the requirement of the shop as a whole by the central controls. Local variations in internal heat load are compensated by 32 room thermostats acting on volume dampers.

The controls for the individual fan type roof ventilators are tied in with the main fan controls so that the exhaust capacity remains in step with the amount of outside air supplied by the supply fans.

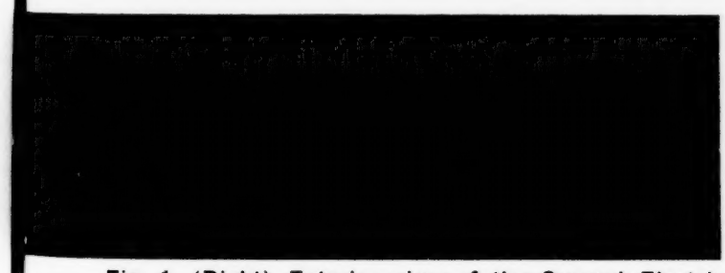
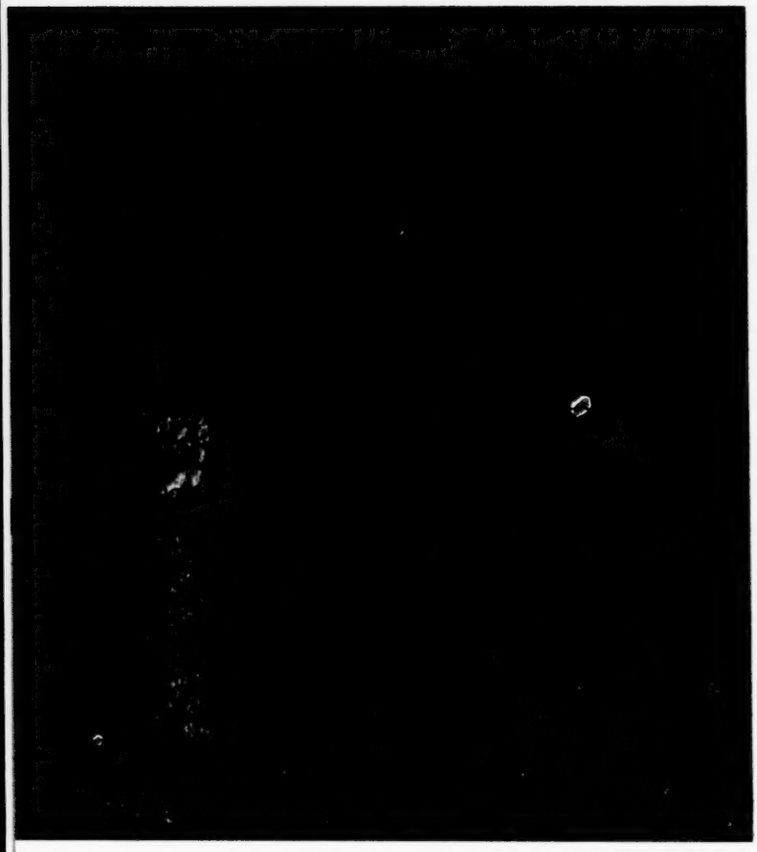


Fig. 1. (Right) Exterior view of the General Electric plant here described. Fig. 2. (Below) Interior view of shop showing overhead ventilating system with Knodraft diffuser outlets. Filtered and heated air is introduced through this system from two central fan rooms.



Steam is furnished by a battery of General Electric oil-fired boilers. There are twelve boilers in all, each having a capacity of 450,000 Btu per hr. These boilers are segregated into two batteries; four boilers supply process steam and operate throughout the year; the remaining eight boilers supply steam for heating and operate as required. In addition to the flexibility in operation it was considered advisable to separate the process boilers in order to avoid the possibility of damage to the heating boilers in case of a leak of acid solution from the plating to the condensate return. All of the boilers operate at 10 lb pressure or less with full automatic controls. The boilers of each battery are connected to a common central header at the water line with circulating connections. All steam is taken off the header and all condensate is returned to the header. While the heating battery thus consists of eight individual units which can be operated individually, in actual operation the battery operates as a single boiler with a capacity of 3,600,00 Btu per hour, but with eight burners that give eight operating control steps as regards capacity. The circulating connections are such that one burner will maintain water temperature in all of the boilers, so that the response is immediate when cutting in another burner for additional capacity. The large central header adds to the stability of operation because of the additional water storage capacity and additional steam liberating surface provided. Boiler operation is wholly automatic without attendance other than occasional inspection.

The boilers are shown in Fig. 4; Figs. 3 and 12 show the boiler piping connections.

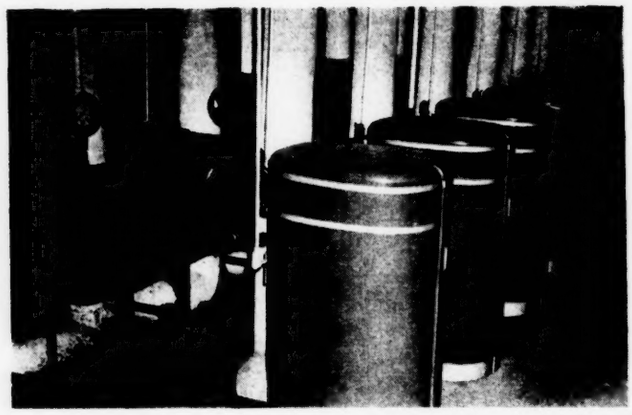


Fig. 4. Twelve G. E. oil-fired steam boilers supply steam for heating and process.

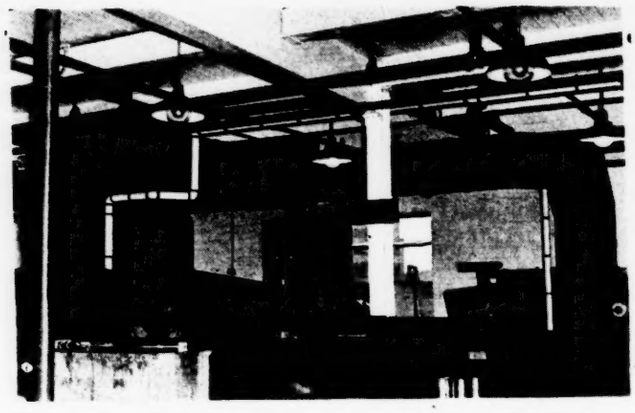


Fig. 5. Ventilation hoods and ductwork connected to exhaust fans draw off fumes from plating tanks.

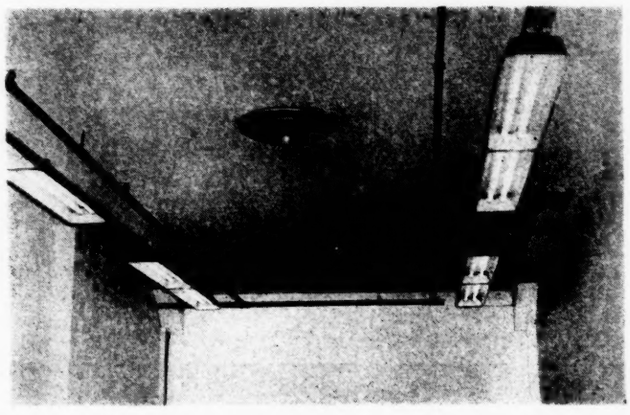


Fig. 6. Complete air conditioning features this gage stock room where precision measurements are made. Air enters through the Anemostats.

Fig. 7. Another view of the overhead system supplying heated and filtered air to the shop.

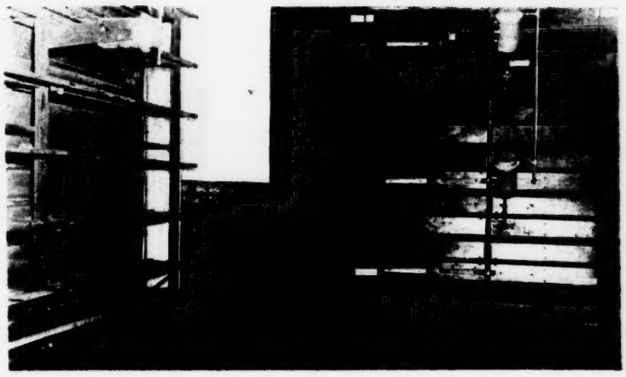


Fig. 8. Inside the air inlet chamber. Johnson Service damper motors control the dampers.

Fig. 9. A view of the Buffalo Forge main heating and ventilating system supply fan driven by a G. E. motor isolated from building structure by Korfund Vibro-Bar integral fan and motor base. Aerofin heating coils in the casing at the left heat the air.

Fig. 10. Front view of the American continuous oil-type air filters, which remove dust from main factory air.

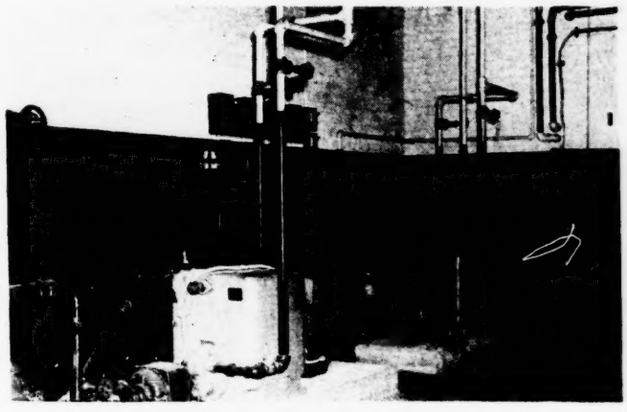


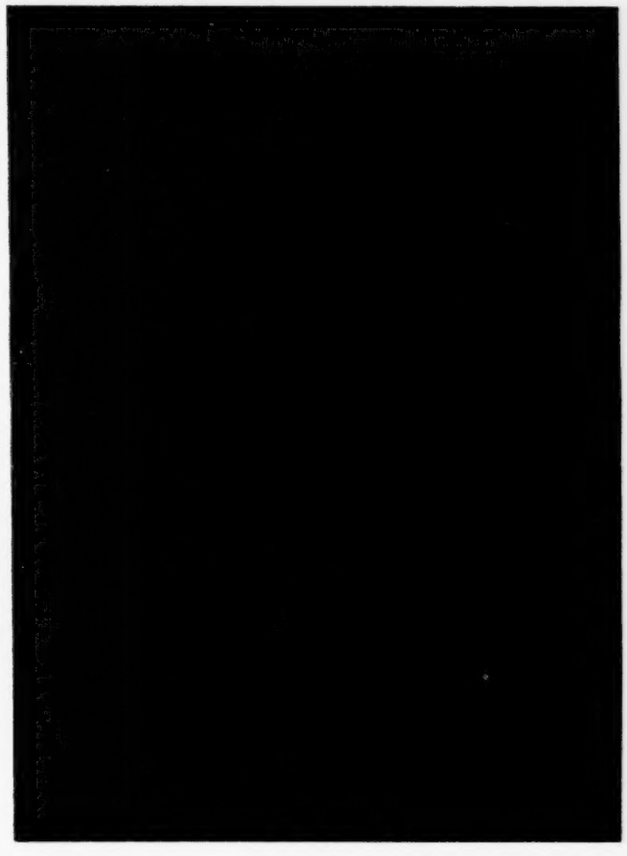
Fig. 11. Two Nash-Jennings condensation pumps, equipped with G. E. motors, in the boiler room.

Heating steam is provided for the two main fan supply units; for unit heaters (used for heating and plating department and toilets, and for taking care of the railroad car door and the truck doors when open); for the heat interchanger which heats water for the forced circulation hot water heating system for the office; and for the storage heater for the domestic hot water. The interchanger and storage heater are shown in Fig. 15.

The offices, cafeteria and kitchen are heated by convector type radiators through which hot water is circulated. Water temperature is controlled automatically in accordance with outside temperature. Room temperature is further controlled by local thermostats acting on motor-operated valves.

Fig. 9 shows one of the main supply fans and also the steam connections to the non-freeze type air heater. This heater has capacity for maintaining shop temperature in shutdown periods, but normally requires very little steam because full advantage is taken of internal heat by the use of recirculated air. The problem here was to distribute the small amount of steam uniformly over the face area of the heater to avoid stratification in the supply air duct system.

Fig. 8 gives a partial view of the outside air and recirculation air dampers which admit the proper air mixture under automatic control to a suction plenum. From this plenum the air passes through an automatic air filter shown in Fig. 10. Thus, all outside air and recirculated air is filtered.



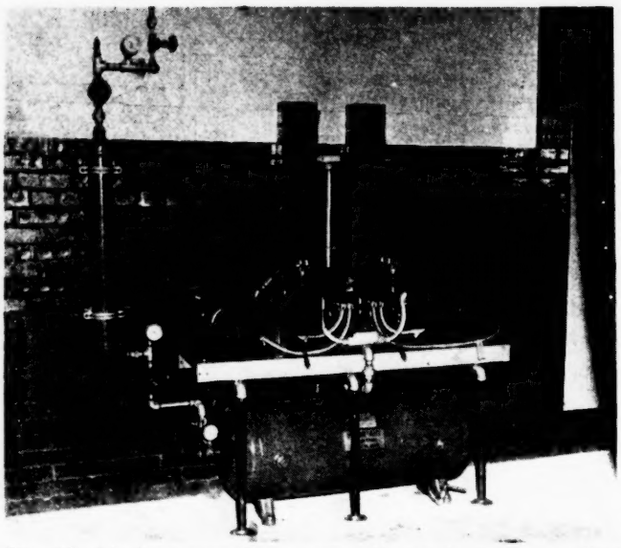


Fig. 13. Air for operating pneumatic controls is supplied by this Johnson Service Co. compressor.

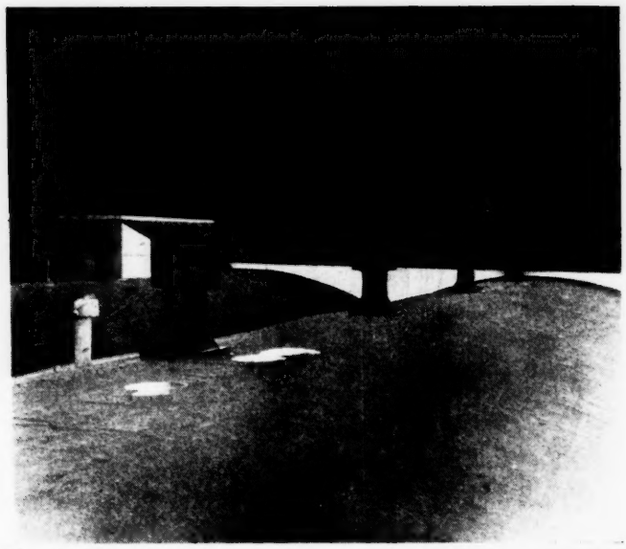


Fig. 14. Burt roof-type exhaust units remove warm air and ma ntain pressure balance within the building.

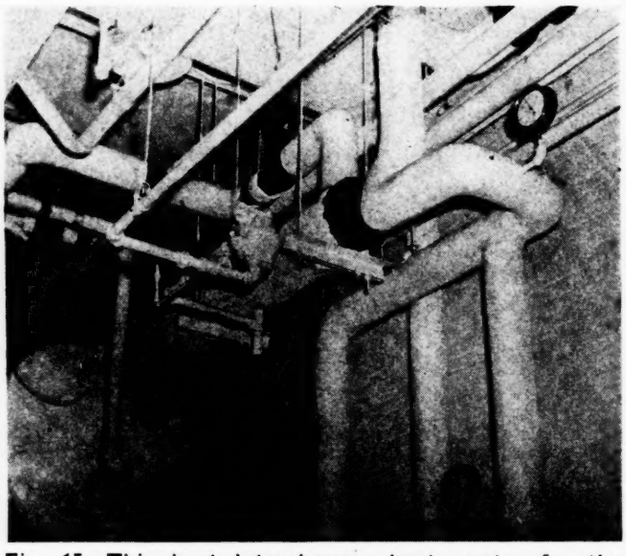


Fig. 15. This heat interchanger heats water for the forced circulation hot water heating system.

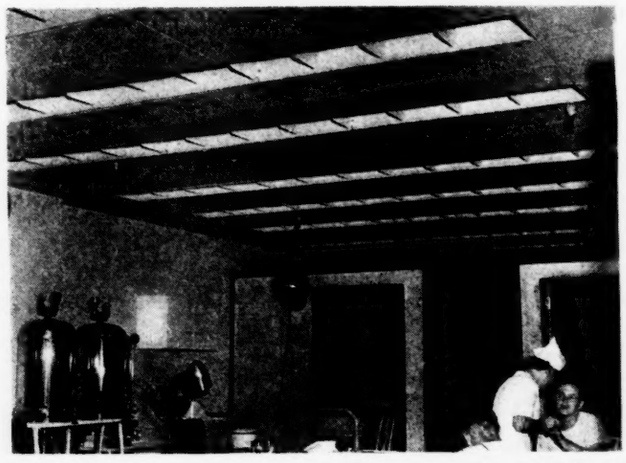


Fig. 16. Several Anemostat diffusers supply outside air to the modern and well ventilated dispensary.

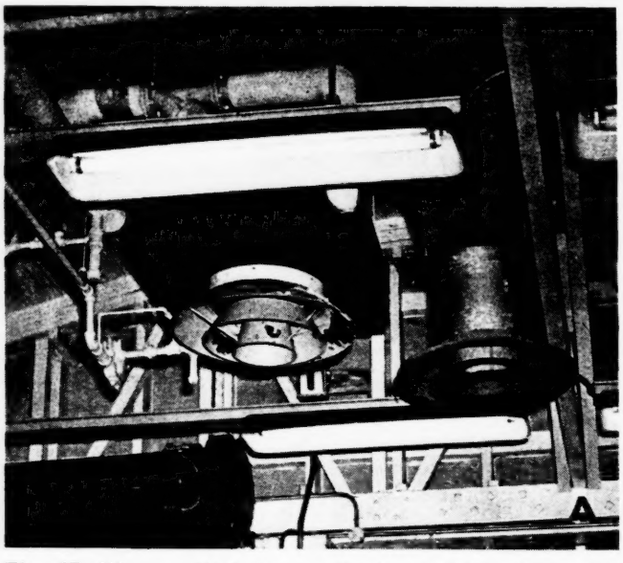
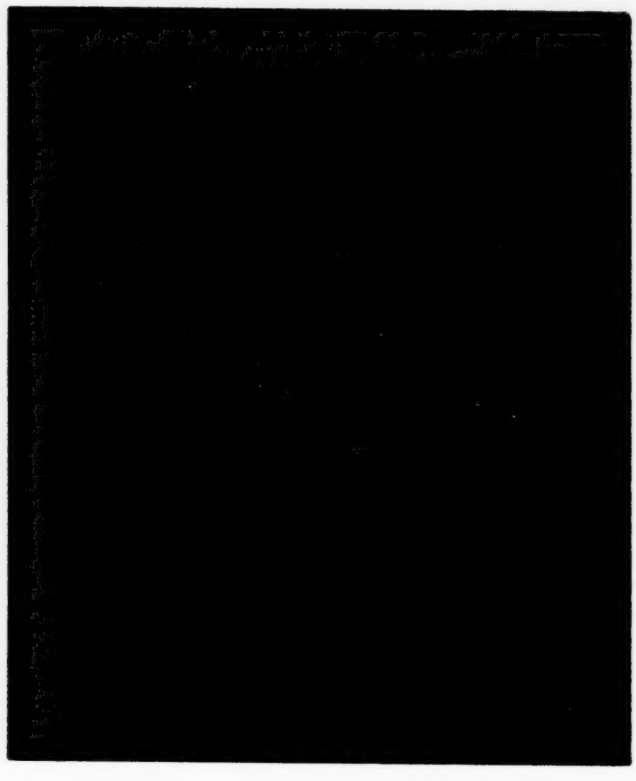


Fig. 17. Warren Webster vertical projection type unit heater with Anemostat diffuser supplements the diffuser outlet shown next to it in maintaining comfortable working conditions when the railroad door at the left is opened to admit cars.



AIRPLANE HANGARS

By ELMO HALL
Consulting Engineer
Denver, Colo.

four in number, are heated by radiant heating system with pipe coils in floor. Small vertical temperature gradient resulted as indicated by tests.

PRIOR to 1942 the author had successfully designed and applied panel or radiant heating in residences, but had never been able to overcome his skepticism regarding the application of this type of heat for industrial uses.

Given the task last summer by the architect's engineers for a large air field, of designing and installing heating in four airplane hangars, at a time when manufacturers of convector type equipment were changing from use of copper and aluminum to steel, the author found that deliveries of this equipment could not be expected until approximately two months after the required completion date. A check-up with one of the pipe manufacturers revealed a sufficient quantity of "bending quality" steel pipe was available, and permission was obtained to design and install what are believed to be the first panel heated airplane hangars in this country.

The four hangars heated are conventional in design except that they are constructed entirely of

wood. Each measures 164 ft × 208 ft, with 20 ft on each side of each hangar taken by offices and work shop. The offices are heated by pipe coils, radiators, or low pressure steam unit heaters, as available. The working space of each hangar, 124 ft × 208 ft × 48 ft, is heated entirely by floor panels. Each end of the hangar is equipped with full width doors, 29 ft-1 in. high. Originally the hangars were only 200 ft long and the floor panels were installed for that length. During construction, it was found necessary to substitute wood doors on a single track instead of multiple-track steel doors, and the hangars were lengthened 4 ft on each end. This leaves the panel 4 ft short of the doors. Additional access doors for personnel were also provided, and, to take care of the expected need for additional heat at these points, four low pressure steam unit heaters were installed in each hangar, one opposite each access door. These, however, have proved to be unnecessary and are seldom used.

Arrangement of Heating Panels

The working space in each hangar was divided lengthwise in the center to form two zones. Each zone consisted of ten divisions, each 20 ft × 62 ft, and each provided with a continuous welded pipe spiral heating panel. Flow connection is made to a main installed in the sub-grade at the center of the hangar, and return connection is made to a return main similarly located near the hangar wall. Each panel is provided with a hand valve designed to permit adjustment of slab temperatures, and accessible in a small box covered with an 8 in. × 8 in. traffic plate.

The floor structure consists of 6 in. of stabilized sub-grade fill which was covered with asphalt felt before the slab was poured. All pipe panels were cast directly in the center of the floor slab, midway between the top and bottom surfaces, and all pipes were carefully cleaned to insure bond.

Pump and Piping Calculations

The pipe panels were fabricated entirely without fittings, using pipe turns bent to 180° over a 12 in. radius. All pipe was reamed and welded to template, and panels were placed as units, 20 ft × 62 ft, on the sub-grade. All panels were hydrostatically tested at 140 lb per sq in. and given a flow test designed to disclose unintended obstructions. The calculated pressure drop per panel is 25.5 lb per sq in. but the actual drop proved to be only 14.8.

Hot water is supplied to each zone of ten panels by a steam generator of 5000 gal per hr capacity. The generator in turn is supplied with steam from a nearby central steam plant. Each zone of ten panels is equipped with a circulating pump rated at 100 gpm at 25 lb per sq in., but since the actual loss is 14.8 lb per sq in., plus uncalculated losses in heat exchanger and fittings, the water circulated is in excess of design, and the figure of 110 gpm, used in calculations, is felt to be conservative.

Controls

Controls consist of a thermostat controlling the circulating pump located in an inclosed door pocket connected to a pneumatic steam modulating valve designed to increase water temperature with outside temperature decrease, and a pneumatic limit control to prevent overheating in case of pump failure.

Results

Certain assumptions on which design was based have proved fallacious. One of these was that floor temperature would have to increase as the outside temperature dropped, in order to secure adequate heat release. This is not the case, and the floor temperature has varied only from 70F at —17F outside, up to 72F at 50F outside. It was also assumed that there would be a temperature drop of approximately ½F per foot vertically above the floor, while actually no drop is apparent in the first 20 ft vertically, except near the walls where cold air sliding off the walls drops the temperature 4F to a point 12 ft from the wall. Above 20 ft the sun effect on the roof is felt, and temperatures of 55F to 85F at 10F outside were noted on the same day, varying with sun intensity.

It will be noted in the accompanying table that the slab temperature dropped to 68F at an outside temperature of —30F, which occurred for four hours only. There was a corresponding drop in the suspended thermometers. This is to be expected since design was for 60F inside at —20F.

This installation has come through the first heating season in a very gratifying manner, and can now be pronounced a success. The lack of air motion is a great contributing factor to comfort, and an executive of one of the large air lines expressed amazement on seeing men and women working on a fuselage 16 ft above the floor, on the wings, on step ladders, and sitting on the floor, all obviously working in the same degree of shirt sleeve comfort.

On the drawing are shown the temperature strata, these temperatures applied to outside temperatures as low as —17F except in the thermometer near the wall at a height of 30 in. These temperatures were constant, except for operational changes, the variable temperatures in the plant being the incoming and return water temperatures. Some temperature data are given in the accompanying table, and translated into equivalent steam radiation.

Tests cover a continuous heating period from

OPERATING DATA FOR ONE ZONE (HALF THE HANGAR)

Outside Temp., F	Flow Temp., F	Return Temp., F	E.D.R. Sq. Ft.	Slab Temp., F.
50	90	84	1370	72
35	101	90	2730	72
15	112	96	3760	71
—10	122	98	5800	70
—17	130	101	6960	70
—30[1]	140	103	8480	68

[1]Four hours only.

November 1, 1942 to May 15, 1943, at which time heat was discontinued. Average mean temperature of all tests under all conditions over this period was 68.5F for the 20 ft space above the floor. Thermostat settings were changed during tests to observe the time required for temperature changes and averaged out at 68F setting.

Heat recovery is very rapid after exposure. During one of the tests at 10F outside, with wind S.E., 20mph, the thermometers in the center dropped 22F when the doors were opened to admit a plane, recovering their original reading in 6½ minutes on closure.

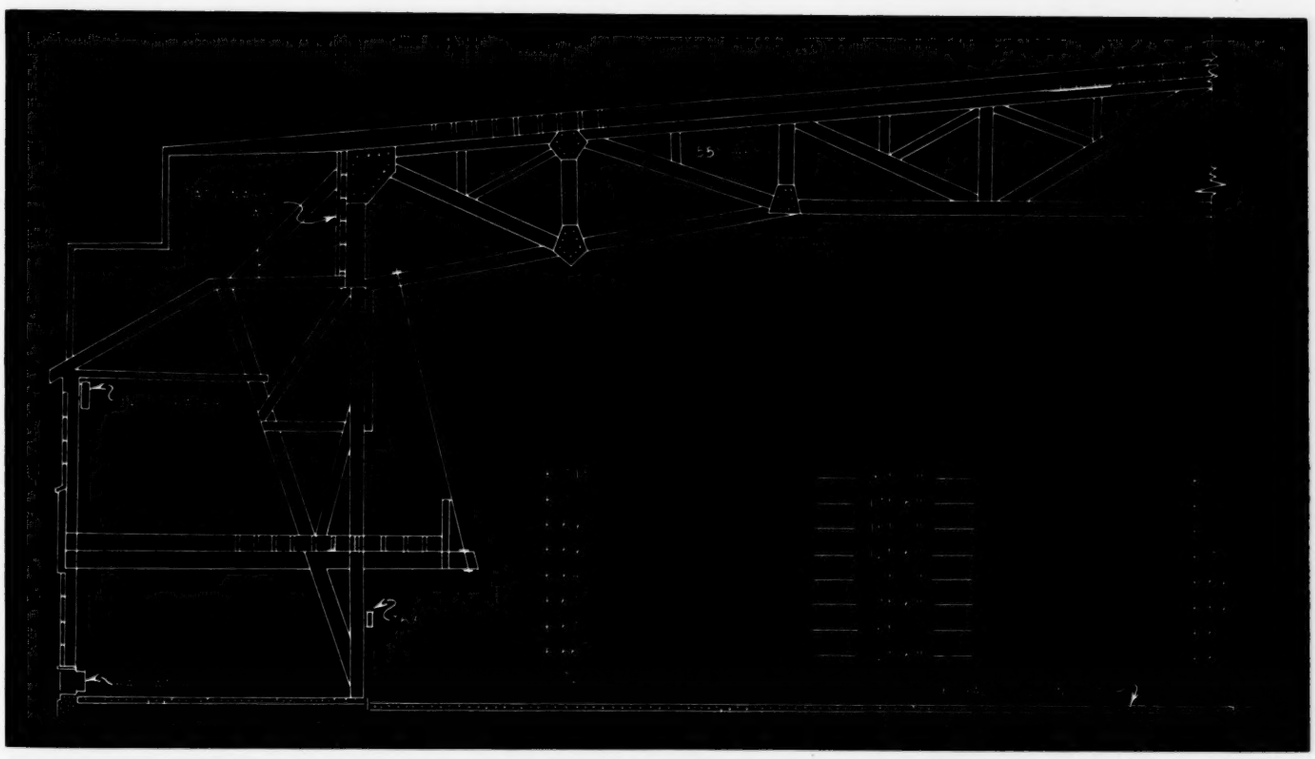
The central heating plant which supplies steam to the hanger heating panels also heats the base photographic building, parachute drying building, bomb sight storage, crash station, and base depot warehouse.

The estimated total coal consumption for the group based on 5800 degree days for Buckley Field was 4410 tons per heating season.

Approximately 40% of the heating plants were in operation Nov. 10, 1942 and all were in operation Jan. 1943. Due to freezing temperatures during May, 1943 the plant was operated until June 1. Considering approximtaely 11% degree day deficiency for the period operated applied against the percentages of the plant in operation it is estimated that approximately 65% of normal operation was achieved during the heating season after the plant was operating. This would indicate a consumption of 65% of 4410 or 2866.5 tons. The total of all coal actually delivered to the plant to June 1, for all purposes, including boiler testing, was reported to have been 1492 tons. Coal supplied is bituminous slack, of approximately 11,500 Btu per lb, as received.

Operating costs are low, the only energy employed outside of the fuel being a 5 hp motor on each zone circulator, compared to an estimated 55 hp on convector fan equipment of the same capacity.

The buildings were built for an Army Air Force technical training command field, under the direction and approval of the Construction Division, U. S. Corps of Engineers. Davis & Wilson were the architects and engineers, E. B. Jones the general contractor, and Olsen & Benbow the heating contractors. Youngstown Sheet & Tube Co., supplied the pipe for the floor panels.



DOUGLAS

...MPANY'S

...r con-
...rgest systems
...Cooling system has
...f 7000 tons. Main building divided into forty zones.

By R. F. HURT
Plant Engineer
Douglas Aircraft Co.
Tulsa, Okla.

THE importance of Air Conditioning in industry has never before been proven and accepted to the extent that it has in some of the new, large plants built during the present emergency. An outstanding example is the Tulsa, Oklahoma, plant of the Douglas Aircraft Company, Inc. The air conditioning demands of this plant with its long main assembly building and several smaller buildings required one of the largest systems ever built for such purposes.

The construction of the entire plant, designed and engineered by The Austin Company and built by the Manhattan Long Construction Company, involved many radical new designs which had not been previously used. Some of these designs will be pointed out in the discussion to follow.

There are four primary considerations which affect the design and operation of such a system, the first of which is outside weather conditions. The design for this system was based on zero D.B. for winter and 100F D.B., 78F W.B. for summer.

The second consideration is the type of building construction. In this case all buildings are of the blackout type without windows or skylights. This feature considerably simplifies design and eliminates practically all the infiltration losses and a large proportion of the conduction losses experienced with other types of construction. In addition, walls and roofs are insulated with spun-glass type insulating materials to such an extent that the load on the system due to conduction is reduced to a small percentage of the total load.

The third consideration is the internal heat gain which is composed of gains due to electrical equipment, process and heat treating equipment and body heat from occupants. In the blackout type of building the heat gain due to the artificial lighting becomes quite important. In the Douglas Tulsa plant this gain was reduced to a minimum by exclusive use of fluorescent type lighting which, because of its high efficiency, produces less heat than incandescent lighting for equal light intensities.

The fourth factor is one which does not ordinarily arise in the ordinary air conditioning problem. This factor is the psychological effect of totally enclosed spaces on the occupants. In most buildings the occupant is able to occasionally see the weather conditions outside and unconsciously makes a mental comparison between inside and outside conditions.

He is, therefore, much more easily satisfied with inside conditions. In the blackout type of building the occupant has no such opportunity for comparison and as a result he is much more sensitive to air temperature and quality. It has been noted at this plant that numerous compaints have been registered when seemingly ideal wet and dry bulb temperatures and air quality prevailed.

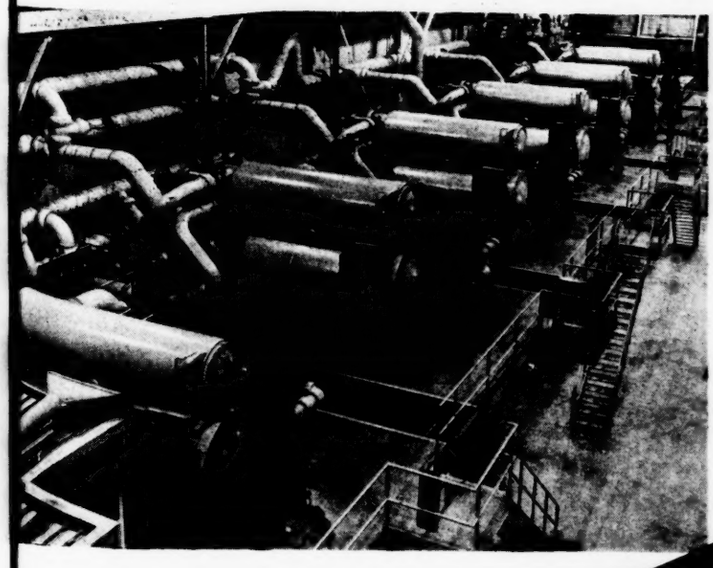
In designing the air conditioning system at this plant the ultimate goal was to provide the best possible control of year-round inside conditions with a minimum of effort on the part of the operators and a minimum amount of equipment. This was accomplished admirably by duplication of only one of the three components of the system, that of generation. It might be said that a good heating system was installed and that the cooling system was added. Of these three components, generation, distribution and control, the distribution and control sections were so designed as to allow operation on both heating and cooling cycles.

Generation

The source of energy for both heating and cooling is the steam generating plant. This plant is composed of three Riley cross-drum steam generators, with water-cooled walls and floors. Each has a capacity of 100,000 lb of steam per hour, continuous rating, at a pressure of 225 psi, using forced and induced draft. Each unit is equipped with an air type of preheater utilizing furnace gases to provide combustion air at from 350F to 450F. From heat balance calculations it has been determined that the air preheater increases overall efficiency of the units approximately 7%.

The generators are fired with natural gas with oil standby using Peabody combination gas and oil burners. The fuel oil system is so designed and installed that change-over to oil firing is quickly and easily effected without interruption of service. Regular operating schedules call for weekly operation on oil for periods of two hours in order to allow constant checking of the standby system and to provide practice for the operators. A light grade of fuel oil is used to obviate the necessity of preheating the oil for use.

Fig. 1. Battery of York refrigerating equipment. Each unit consists of a compressor, condenser, water chiller, and steam turbine drive. Chilled water piping header is installed against the wall.



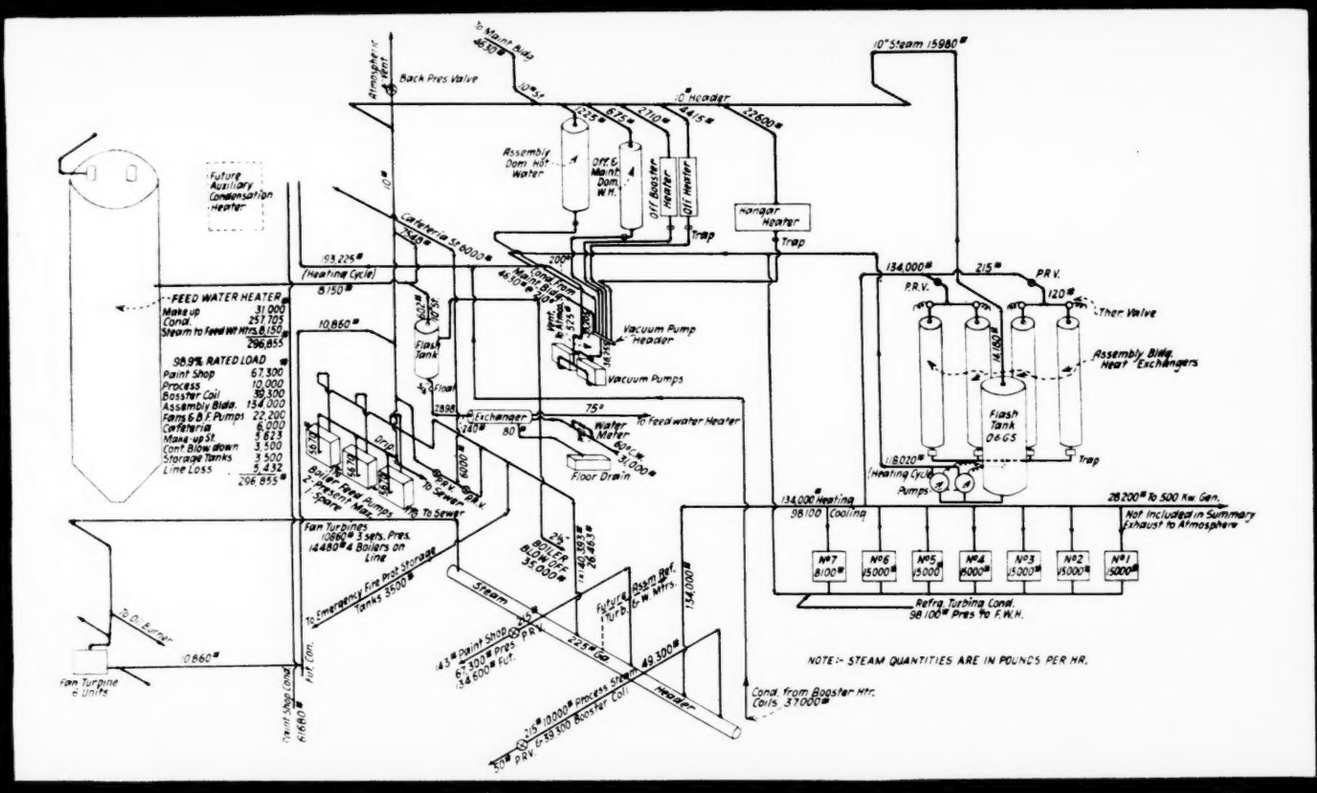
Combustion is controlled by a Republic Smoot system of automatic controls which maintain both a constant steam pressure and a constant fuel-air ratio, regardless of load conditions. In providing combustion controls for this system it was necessary to allow for sudden and wide fluctuations of steam demand without sacrificing close steam pressure control and combustion efficiency. Such fluctuations result from electric power failure, which causes distribution fans to stop and thus reduce steam demand; intermittent running of steam-driven refrigerating units during intermediate seasons; and automatic safety shutdown of refrigerating units. Intermittent demands of the heating system at the paint shop also cause large fluctuations in load.

The combustion controls allow either manual or automatic operation, maintaining constant fuel-air ratios on either. Twenty-four-hour charts averaging 10.5% carbon dioxide in the flue gases without the presence of unburned gases are a common result. An interesting feature of the control system allows ratio loading of the generators regardless of total load variations. This feature allows the operator to adjust any one of the boilers to carry any fixed percentage of the total load without regard to variations in steam demand. This allows all three boilers to be controlled from the same steam pressure controlling element and prevents one boiler from getting "out of step" and attempting to "hog" the load.

Fig. 14 is a front view of two of the steam generating units showing the combustion control panel and the combination gas and oil burners. Fig. 4 is a closeup of the combustion control panel. Included in the recording instruments are, a Republic three-point air preheater temperature recorder, Republic CO_2 recorder, Bailey steam-flow-air-flow meter, and Republic draft gages.

A view of the rear of the generators is shown in Fig. 17 illustrating Sturtevant draft fans, Moore fan turbines, and one of the combustion air flow regulators controlling the fan turbines.

Boiler feed water treatment is handled by a Permutit hot lime-soda system with deaeration. Chemical feed to the water treater is automatically con-



trolled according to the rate of raw makeup water flow, resulting in extremely close control of boiler feedwater conditions. This treatment is supplemented by internal treatment to insure zero hardness of boiler water and complete removal of all oxygen from the water. Continuous blowdown is used, the blowdown water being run through a heat exchanger which utilizes waste heat of the water to preheat raw makeup water.

The steam requirements of the plant include winter heating, manufacturing processes, cafeteria cooking, domestic hot water heating, and power for the steam turbine-driven refrigerating machines.

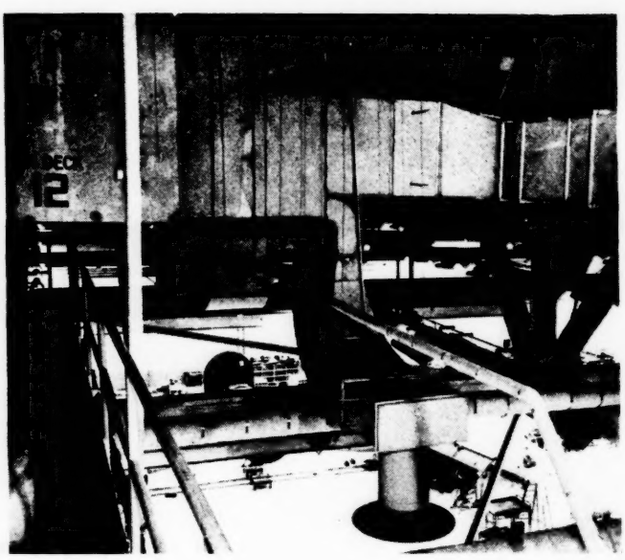
Distribution of heating and cooling effects is accomplished with a single system of water circulation. During the winter heating season the water is heated by steam heat exchangers and circulated to convectors at various locations in the plant. During the summer months the same water is cooled by the refrigerating machines and distributed to the convectors.

The refrigerating part of the system consists of seven York centrifugal compressors, driven by Worthington-Moore multistage condensing steam turbines. Six of the units have a capacity of 1075 tons each and the seventh 550 tons, making a total of 7000 tons capacity. Each of the units is complete with refrigerant and steam condensers and water cooler. The refrigerant employed is Freon (F_{11}). This refrigerant is used because of its low operating pressure characteristics. This is an important factor in units of this size because the large compressor and chiller total surfaces which are subject to the refrigerant pressure results in high total internal stresses in the equipment. Each of the six large units contains 3000 lb of refrigerant and the smaller unit 2400 lb.

Fig. 1 is a general view of the refrigerating units which are located on a raised deck above the main floor, thus providing space beneath the units for the steam condensers and auxiliary equipment.

Fig. 9 is a closeup of one of the 1075 ton units, showing the Taylor controls and the instrument panel. Recording instruments here include chilled water inlet and outlet temperatures and flow through cooler, condenser water inlet and outlet temperatures

Fig. 3. A section of distribution ducts leaving fan room is shown, with Barber-Colman automatic summer and winter diffusers.



and flow through the refrigerant condenser, and steam condenser water outlet temperature and steam flow to the turbine.

In addition to the refrigerant and steam condenser and the cooler mentioned above, each unit is equipped with an intercooler and steam condenser evacuator.

Safety protective devices installed in the control circuit of the units effect immediate shut-down in case of low cooler temperature, excessive refrigerant head pressure, high lubricating oil temperature, and low oil pressure.

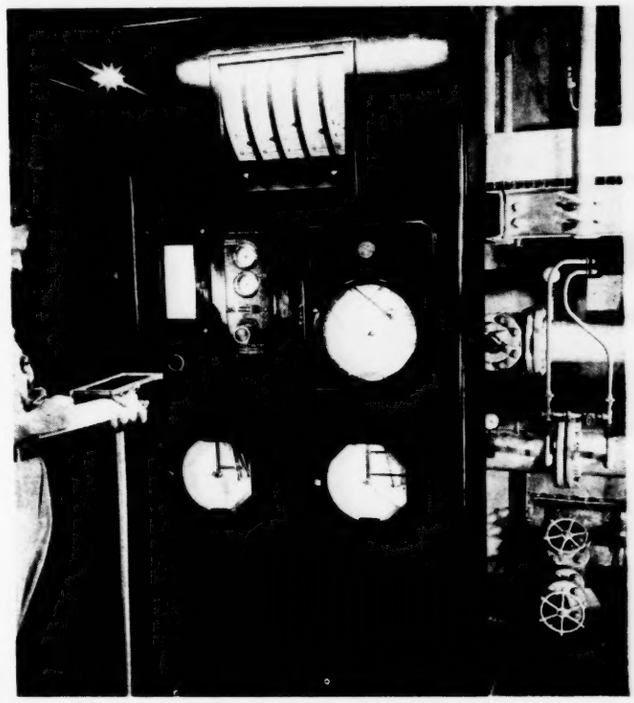
In addition to safety devices which stop the units when dangerous conditions arise in temperatures or pressures there are signaling devices that warn the operator with lights and bells when critical conditions approach. Such warnings allow time for operators to make corrections and adjustments and thus prevent stoppage of the unit.

Although the manufacturer's rating on the large machines is 1075 tons and 550 tons on the smaller unit, it is possible to produce up to 1300 tons and 650 tons, respectively, depending upon chilled water outlet temperatures.

Fig. 7 shows two of the four water pumps for circulating heated or chilled water to the convectors in the fan rooms. Fig. 18, right, gives a diagrammatic picture of water flow. The same water circuit and convectors are used for winter heating and summer cooling. The water piping is so arranged as to permit circulation through the heat exchangers for heating or through the refrigerated coolers for cooling.

Operation of the units is automatically controlled by chilled water outlet temperatures by means of Taylor temperature controllers. These controllers are actuated by a thermostatic element located in the chilled water header and vary the speed of the compressors according to chilled water temperature demands. Changes in chilled water temperature produce changes in air pressure in the main air-operated control circuit. These changes in air pressure actuate a diaphragm-operated oil valve on each turbine and thus position the hydraulic steam throttling valve.

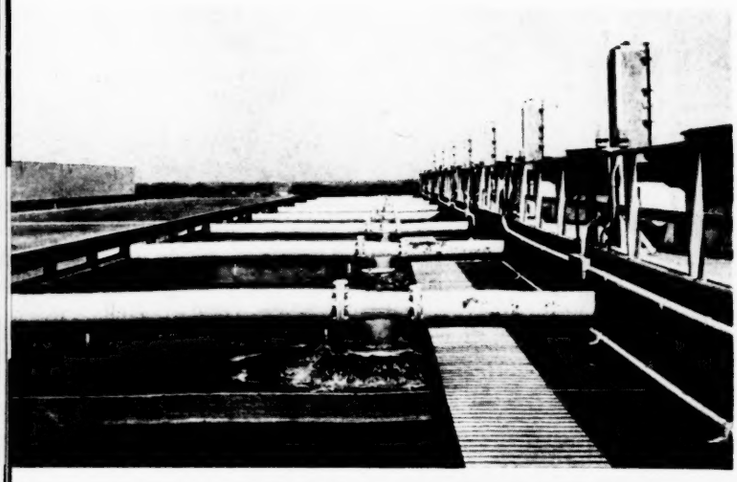
For control of temperatures in the smaller cafeteria, office, maintenance, and hangar buildings a novel arrangement of interchangers provides a separate secondary water circuit for each building. The chilled water from the refrigerating units is circulated through these interchangers which in turn furnish cold water for circulation to each of the buildings. In this way the chilled water temperature to each of the smaller buildings may be closely con-

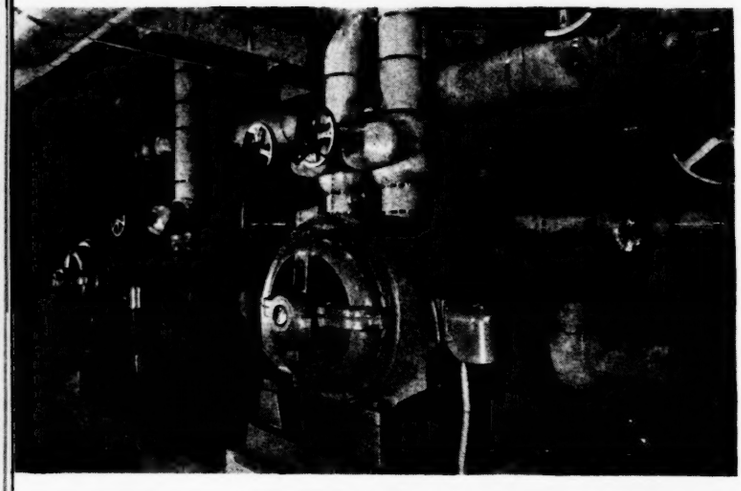


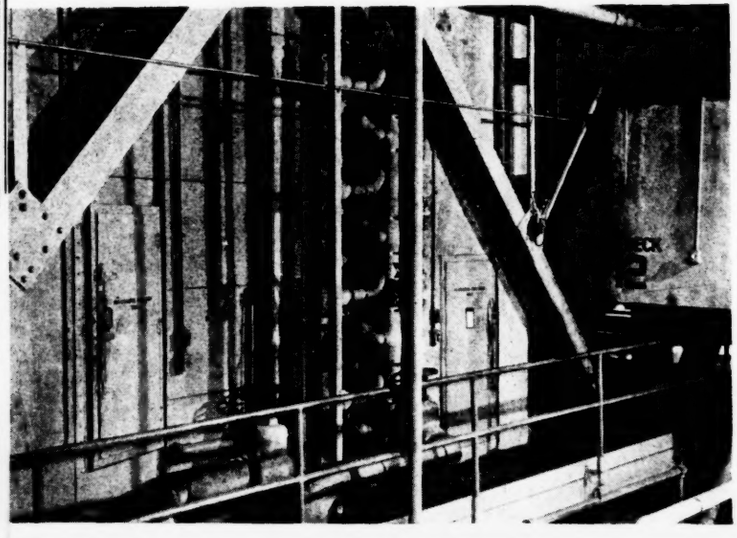
trolled according to individual demands of each.

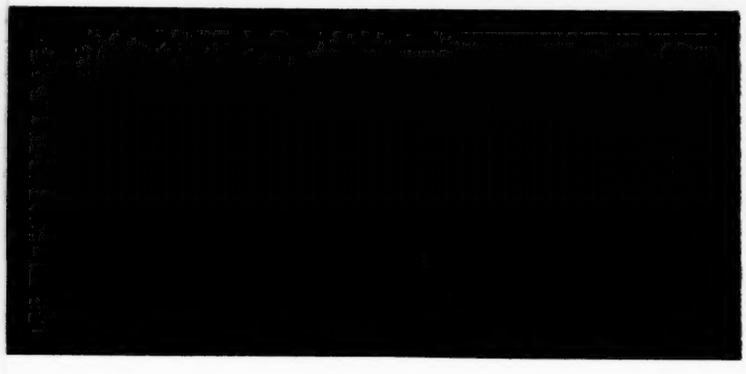
Condensing water for the steam and refrigerant condensers is produced by a Marley induced draft, double flow cooling tower located about 800 ft from the engine room. This tower, having a capacity to cool 25,000 gpm through 23F at a wet bulb temperature of 78F, is made up of nine sections, each of which can be independently operated. This feature allows flexibility of operation and close water temperature control. Figs. 5, 6, 12, are views of the cooling tower showing, respectively: side, closeup of water spreader, and induced draft fans on top. The tower measures 216 ft × 60 ft × 25 ft high. Pumping equipment for the condenser water is located in a pump house adjacent to the tower and supplies the engine room through 36 in. supply and return lines.

Fig. 16 is a section of the pump house showing the









Allis Chalmers synchronous motor-driven condenser water pumps, two of 9000 gpm capacity and one of 6000 gpm.

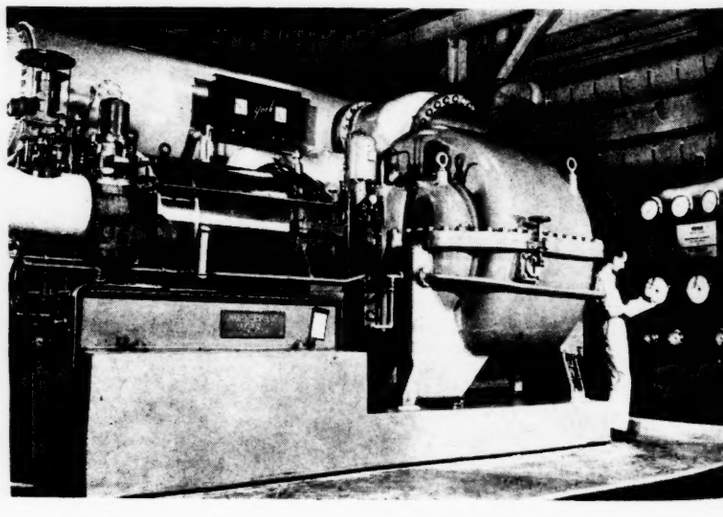
Hot water for winter heating the main assembly building is provided by four Joseph A. Coy Company heat exchangers located near one end and at the edge of the refrigerating deck. Steam for these exchangers is supplied from the same header that supplied the steam turbines on the refrigerating machines. The steam supply is reduced at the heaters from 225 psi pressure to 100 psi. The condensate from the heaters goes to a flash tank where it is allowed to flash at 10 lb pressure. The resulting flash steam is used for feed water heating and for heating water for the cafeteria, hangar, office and maintenance buildings. The condensate is returned to the boiler room for reuse.

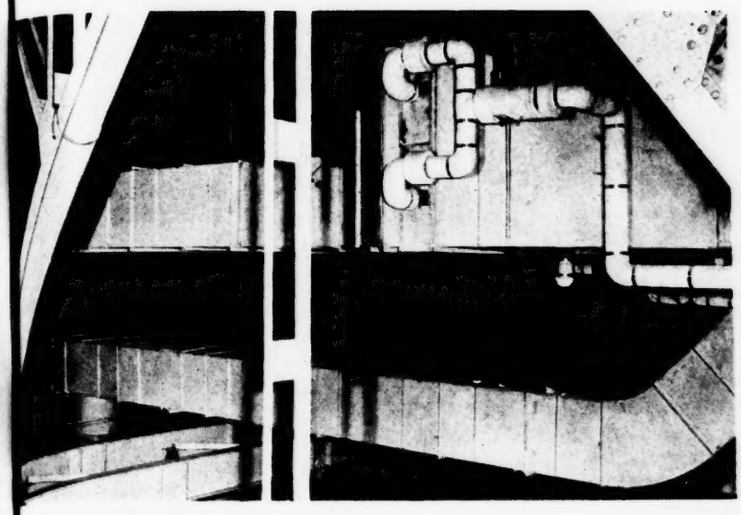
Each of the four heaters has a condensing capacity of 33,000 lb of steam per hour. Water temperature from these heaters is controlled by a Taylor liquid temperature controller similar to those controlling the chilled water temperatures. Fig. 11 gives a partial view of these heaters.

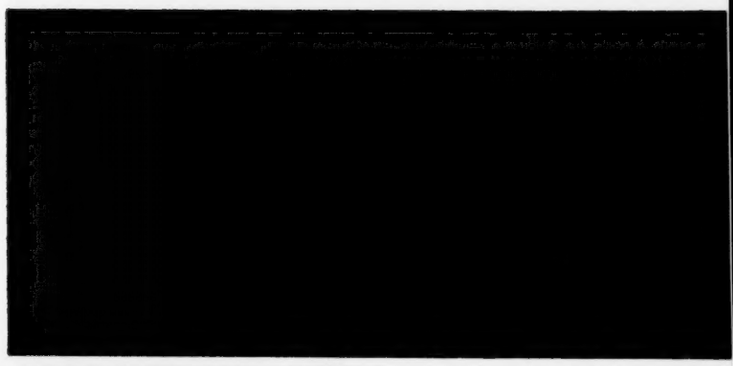
Distribution

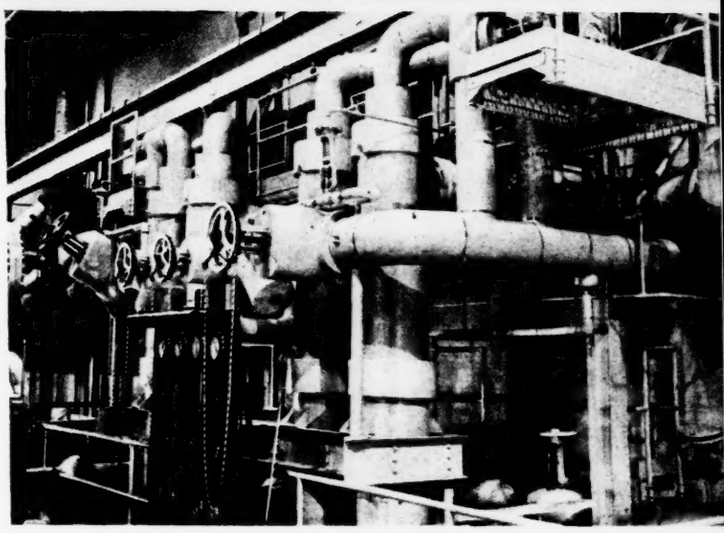
For purposes of temperature control the main Assembly building, which is 4000 ft long by 320 ft wide, is divided into forty zones, each 100 ft by 320 ft. Each zone is supplied by an integral fan room in which are installed a fan, convector coil, water spray, air filter and louvers for controlling outside air and return air. Exhaust louvers are located in the building wall between fan rooms. Fan rooms are arranged in pairs at 200 ft intervals throughout the length of the building and 120 ft from one wall near the roof. Air distribution ducts branch out from each fan room carrying conditioned air to various sections of the zone. Fig. 3 shows one of the fan deck units. Fig. 18, left, shows a typical arrangement of a fan room, including the roof structure at this point which allows proper location of the outside air louvers.

Automatic self-cleaning air filters are installed in each fan room. These filters are American Air Filter Co. viscous type. They are made up of in-





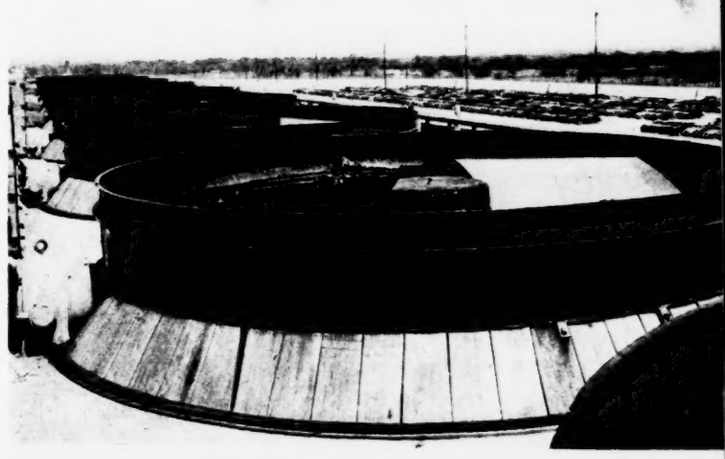




dividual metal filter leaves carried on a moving chain sprocket driven by automatically-timed electric motors. During operation the dirt-filled leaves are carried down into an oil bath which cleans the leaves whence they are carried back into the air stream. The filter oil is cleaned periodically by raking sediment from the bottom of the reservoirs and by filtering.

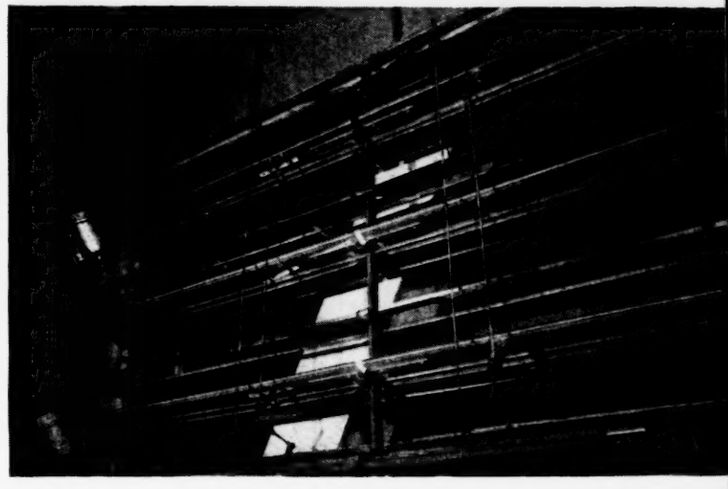
Fig. 8 shows a water spray in one of the fan rooms. These sprays are used for economy or evaporative cooling during intermediate seasons when outside wet and dry bulb temperatures are such as to make this type of cooling effective.

Fig. 13 illustrates a set of Johnson Service Company return air louvers with piston-type air motor control. Barber-Colman grilles are used for distribution of air at the outlet of the ducts. These grilles are so constructed as to allow directional control of air flow for different seasons. During winter heating the grilles direct the air downward to the floor to prevent short circuiting of the heated air back to return air louvers. During summer cooling the grilles direct the air out at right angles to the delivery throat. This prevents channeling of cool air direct to the floor and thus eliminates hot and cool spots in the zone. The directional control is accomplished by means of solenoid-operated vanes in the grilles which are automatically set by thermostats placed in the air ducts.



Air ducts supplying spaces near outside walls, where heat losses are greatest, are equipped with steam booster heater coils. These coils are controlled by sub-zone thermostats placed on the outside walls and supply super-heated air to these outside wall spaces. Fig. 10 is a view of one of the ducts at the point of location of the booster coil.

Distribution to the smaller buildings is similar to that in the Assembly building except that no water sprays are employed in the Office and Cafeteria buildings, and directional grilles are not used in any of the buildings except the Hangar. In the Office Building booster coils are used for summer humidity control by sub-cooling the outside air for moisture removal and then reheating.



Controls

The air conditioning controls for the entire plant were manufactured and installed by the Johnson Service Company. They were designed for dual purpose operation in that they provide inside temperature control for both heating and cooling cycles. Extreme accuracy of control has been accomplished even, under some conditions, at the expense of efficiency of operation. The entire system is pneumatically-operated.

As mentioned previously, the main Assembly building is divided into forty zones each of which is under the control of a zone thermostat. Each zone also has two sub-zone thermostats controlling the booster coils supplying the outside wall spaces. The zone or main thermostats are the basic controls for each zone, being supplemented by the sub-zone thermostat only during the winter heating season. Booster heating, of course, is not used during the summer cooling season.

The thermostats are of the dual-purpose type, constructed of two thermostatic elements built into one case. During the winter heating a rise in temperature results in increased air pressure to louver controls. With summer cooling the action is reversed in that a rising temperature produces a lowered air pressure in the control air line.

Temperature regulation in each zone is provided by action of the thermostats controlling the convector face and by-pass dampers, outside air dampers, and relief dampers. The control sequence is as follows: With a rising temperature when heating, the convector face damper closes and the by-pass damper opens, permitting air to by-pass the convector coil. If a further rise in temperature occurs the fresh air damper opens to bring in cold outside air, and the relief air dampers also open. This action prevents "overshooting" of zone temperatures and is one of the features referred to above which sacrifices economy of operation for close temperature control. The entire sequence of operation will result from a 2F rise in temperature. During times when normal zone temperatures prevail the outside air dampers remain in their minimum position, this minimum position being adjusted from the central control panel to meet ventilation requirements.

The control of inside temperatures resulting from opening of large doors provides an interesting sidelight to the matter of controls. There are large doors at either end of the main Assembly building which when raised virtually open up one whole end of the building. In order to prevent excessive temperature variations when these doors are raised two actions are automatically taken by the controls. When any one of the doors is opened a mechanical device mounted on the door causes all relief dampers in the building to close, thus increasing the positive pressure within the building and causing all excess air to exhaust out through the open door. If, in spite of this action, the temperature at the end zone changes too much, a thermostat causes the air supply to the distribution duct across the end of the building to

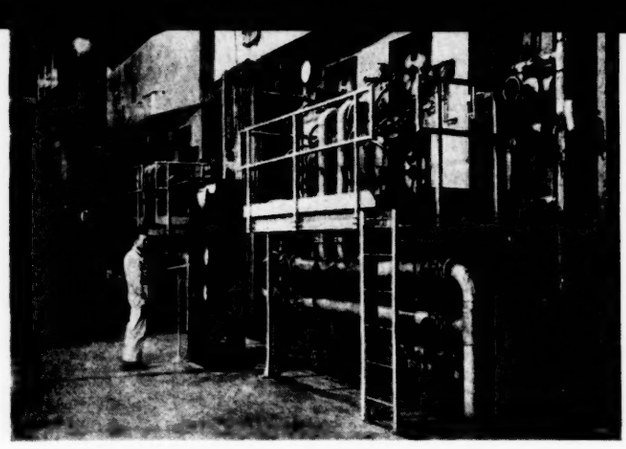


Fig. 14. Riley water tube gas boilers with working pressure of 225 lb. and 100,000 lb. per hr capacity.

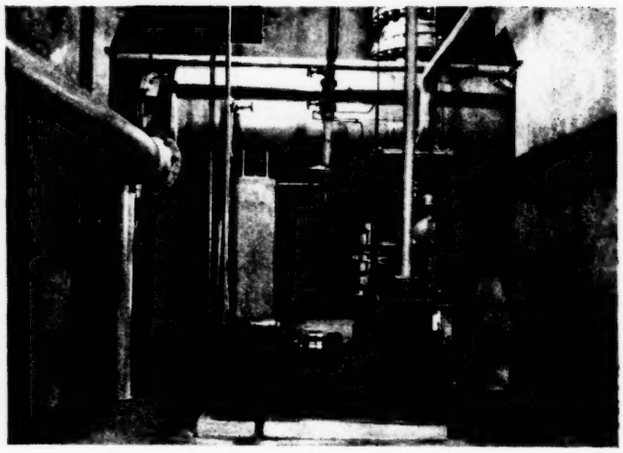


Fig. 15. Directly below the deck of refrigerating units are steam turbine condensers, hot wells, and condensate pumps

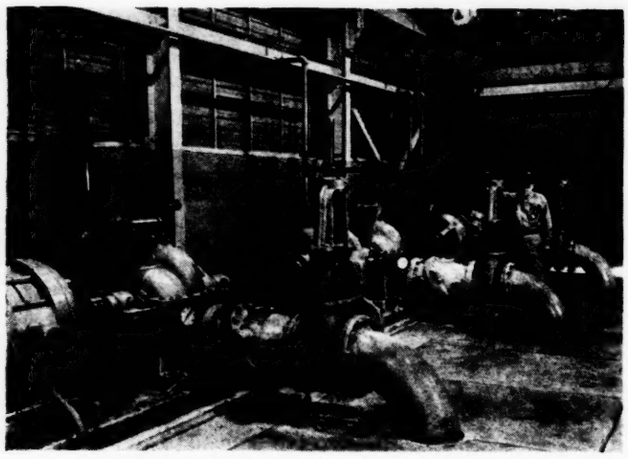


Fig. 16. Allis-Chalmers condenser water circulating pumps with Chapman checks on discharge side.

Fig. 17. Sturtevant forced draft fans driven by Moore turbines are installed in the power plant.

be switched to an auxiliary parallel duct which is equipped with open type high velocity nozzles. The air discharging from these open nozzles forms a curtain across the door opening and further prevents infiltration and also provides a quick recovery of normal temperatures after the door is closed.

The nerve center of the control system is the master air conditioning control panel. From this panel the operator can make almost all routine adjustments to air conditioning controls as well as observe the actual operating conditions at almost any point throughout the entire plant. From this point it is possible to observe and control (1) outside air damper settings, (2) zone thermostat setting, (3) water spray operation for evaporative cooling, (4) position of shut-off valves in steam booster coil lines, (5) chilled or hot water supply temperatures, and (6) office reheat coil water temperature. It is also possible to observe the actual temperature prevailing at any one of the main zone or sub-zone thermostats throughout the entire plant. This is done by switching a single dial indicator to any one of the leads from thermocouples located adjacent to each of the thermostats. A Bristol 4-point strip recorder makes continuous recordings of inside wet and dry bulb readings at a midpoint in the Assembly building and of outside wet and dry bulb conditions. Other instruments and pilot lights indicate position of large Assembly building doors, circulating pumps in operation, refrigerating machines in service and whether they are on manual or automatic control; automatic safety shut-down of refrigerating machines, control air supply pressure, boiler steam pressure, and operation of control system, whether on summer or winter cycle.

Operation

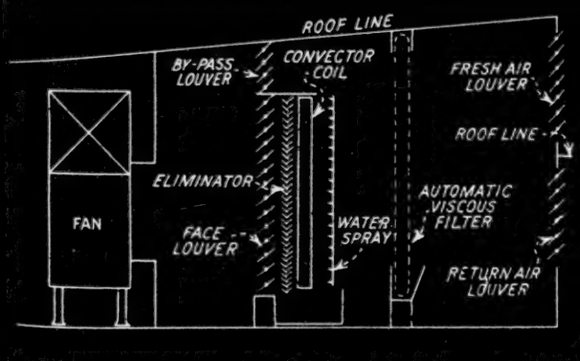
Operation of such a system as this required full consideration of a large number of factors in order to combine satisfactory results with maximum efficiency. During the first year of operation it was necessary to do considerable experimenting in order to determine the most satisfactory and most economical operating conditions. In many cases several weeks were required to complete adjustments to various components of the system after operation had started. Experts from equipment suppliers spent considerable time at the plant completing adjustments and instructing operators.

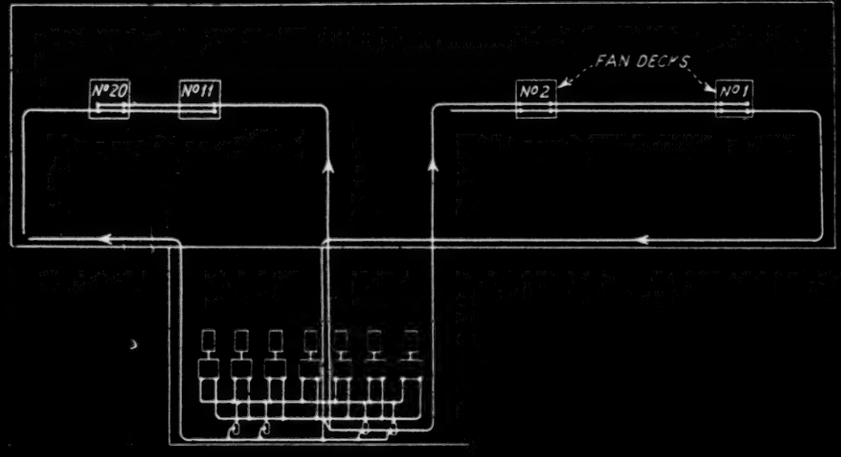
From suggested schedules set up by the designers and from actual operating experience it was found that the commonly accepted degree-day basis of 65F for zero steam consumption for heating did not apply to this plant. The actual heating and cooling schedule now employed is as follows: With a rising outside temperature during the heating cycle and at an outside temperature of 40F the main heating (hot water) is shut off and the load is carried by the booster coils until the outside temperature reaches 50F. At this point all heating is shut off and outside air is used by manually controlling the outside air dampers. Between 60F and 70F outside dry bulb, evaporative cooling is used if the outside wet bulb temperature is within certain permissible limits. Otherwise refrigeration is used. In some cases outside air is used as a control of relative humidity during winter heating.

In order to avoid excessive shock to occupants leaving the building during summer conditions it has been found practical to raise inside temperatures starting about 45 minutes ahead of a change in shift and then resetting the temperatures after the shift is completed. In this way comfortable working temperatures can be maintained without undue physical hazards to the workers.

The operation of the air conditioning system is carried on by a corps of 36 operating engineers of four different qualifications. These qualifications include experience in handling of large steam generating equipment, refrigeration equipment, air distribution, and temperature control. In addition, instrument technicians maintain regular schedules of checking and calibration of all instruments and meters. A separate engineering group computes daily operating results from flow charts, meters, and other instruments and combines them into daily and monthly operation reports which include costs of operation and maintenance. This group also conducts periodic tests on the equipment and constantly searches for means to improve efficiency of operation. This is important in a plant of this size where monthly cost of fuel alone runs into thousand of dollars.

The foregoing discussion has covered only the more prominent details of construction and operation of the Douglas Tulsa Plant. Needless to say, there are many other unusual and interesting details which would be of interest to the air conditioning engineer.





By RALPH C. HITCHCOCK
Mechanical Equipment Engineer
Boeing Aircraft Company

ABOUT 15 years ago aircraft design had progressed to the stage where pilots and their passengers were brought in out of the wind and weather to enjoy the comparative luxury of enclosed cabins. Along with this far-reaching development there came into existence the problem of heating and air conditioning of aircraft—a problem which has become more and more complex as larger, higher flying and faster flying aircraft were built.

In the airplane of today, cabin heating and ventilating is a necessity for passenger safety and comfort. Satisfactory cabin heating and ventilating is also required to provide crew members a proper atmosphere for maximum operating efficiency. This is particularly true, of course, for long range bombers and transports. From the standpoint of safety, heat deicing and defrosting of windows—particularly the pilot's and co-pilot's windshields—is essential for all-weather flying.

Viewing the problem from another direction, we may say that all airplanes carry cargoes, either human or inanimate, and that heating at least is usually required. Passengers will consider comfort and convenience in selecting their mode of travel. Thus the commercial operator having optimum air conditioning, other things being equal, will enjoy the greatest business. Inanimate cargoes, particularly of a military nature, generally include vehicles whose coolants, lubricants, and starting characteristics may seriously suffer unless heat is available during air transport.

Heating and ventilating requirements are generally similar for both military and commercial aircraft. Operating personnel for either type must be comfortable and must be able to see clearly. In the case of bombers this means that cabin heating and ventilating requirements are practically equivalent to those of commercial passenger-carrying aircraft. Similarly, our future commercial cargo transports will require air conditioning to protect their cargoes much as our present military cargo airplanes have such requirements.

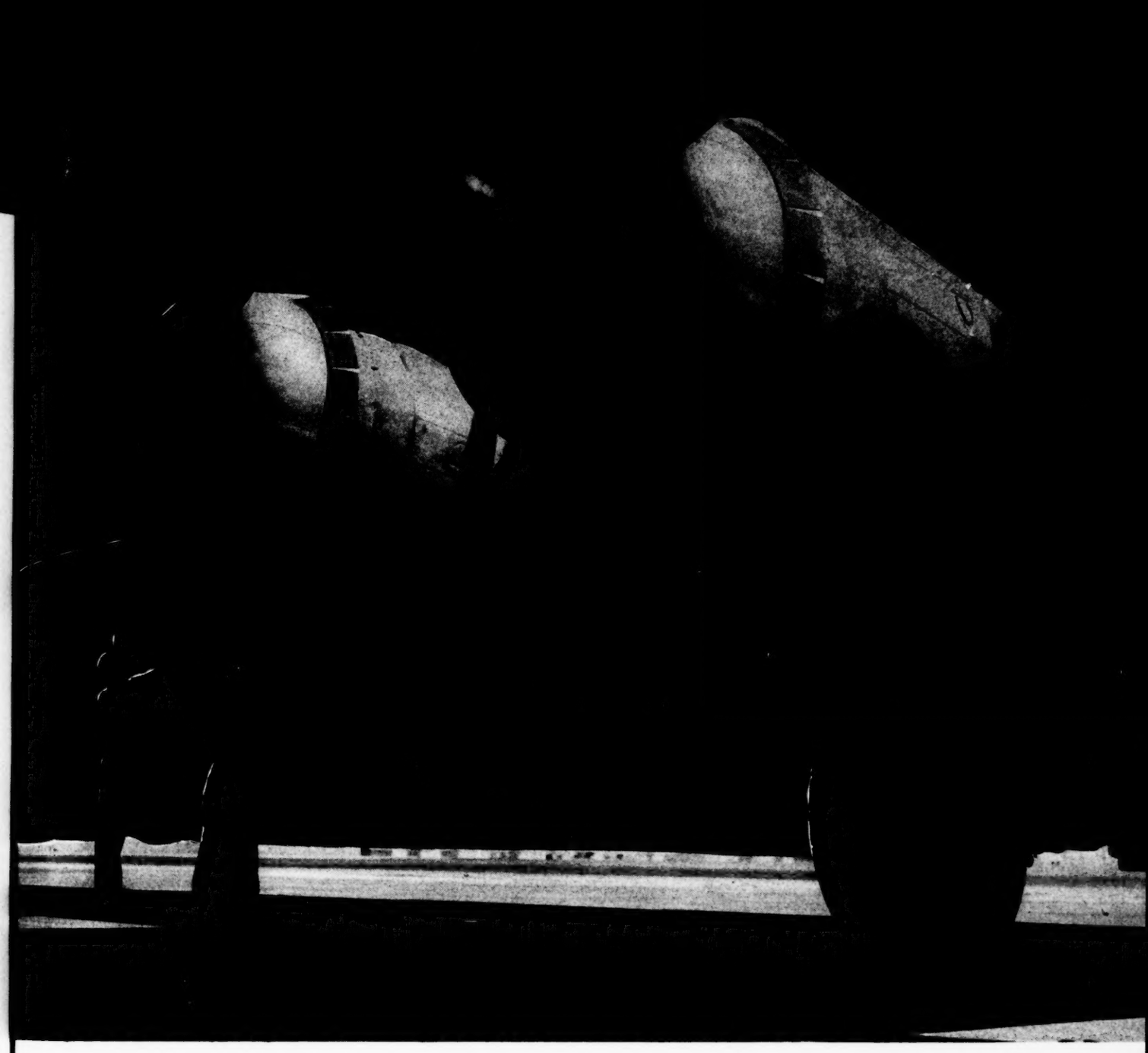
One important item affecting cabin heat requirements is the extreme difference between average cabin temperature and outside air temperature. The standard temperature of the air above an altitude of approximately 35,000 feet has arbitrarily been set at —67F by the National Advisory Committee on Aeronautics. However, temperatures below —100F have been recorded at 40,000 feet in the north temperate zone, this being, of course, an unusual case. Cabin temperatures of 68F to 75F are desired, provided abnormal radiation heat gains or losses are not involved.

Based on these figures, a design cabin temperature differential as high as 170F might be selected, although the probability of such a high differential being required is remote. Thus most cabin heating specifications at present require temperature differentials from 75F to 120F, depending on the type and ceiling of the aircraft involved. Radiation heat losses and gains are taken care of in one specification by the requirement that cabin temperatures be measured with thermocouples embedded in painted aluminum blocks, thus providing a truer indication of the effective cabin temperatures.

There are several heat losses and heat gains which affect the final cabin heating requirements of aircraft. Two major heat losses are involved: first, the loss of heat carried out by the ventilating air which includes, in most aircraft, very large infiltration losses, and second, heat transfer loss through the cabin walls to the outside air.

Compensating these losses are several heat gains. Solar radiation is an important source of heat, particularly since the war started because the camouflage-painted exteriors of aircraft allow greater radiation heat gain. The heat from human bodies is considerable, particularly in troop transport aircraft. The heat given off by electrical equipment installed in aircraft is also great as most large ships carry a surprising amount of this equipment. In the case of cabin supercharged aircraft, the heat of compression from cabin blowers is of major importance. Generally speaking, after-coolers must be provided to take care of this heat.

Several cabin ventilating requirements must be considered. The primary requirement is, of course, provision of sufficient air for human usage. The carbon dioxide concentration must be kept sufficiently low. Sufficient dilution to minimize or nullify disagreeable odors must be maintained by bringing in quantities of fresh air. Enough air must be supplied to limit entering air temperatures to a comfortable value. General aircraft practice requires entering ventilating air temperatures below 200F. However,

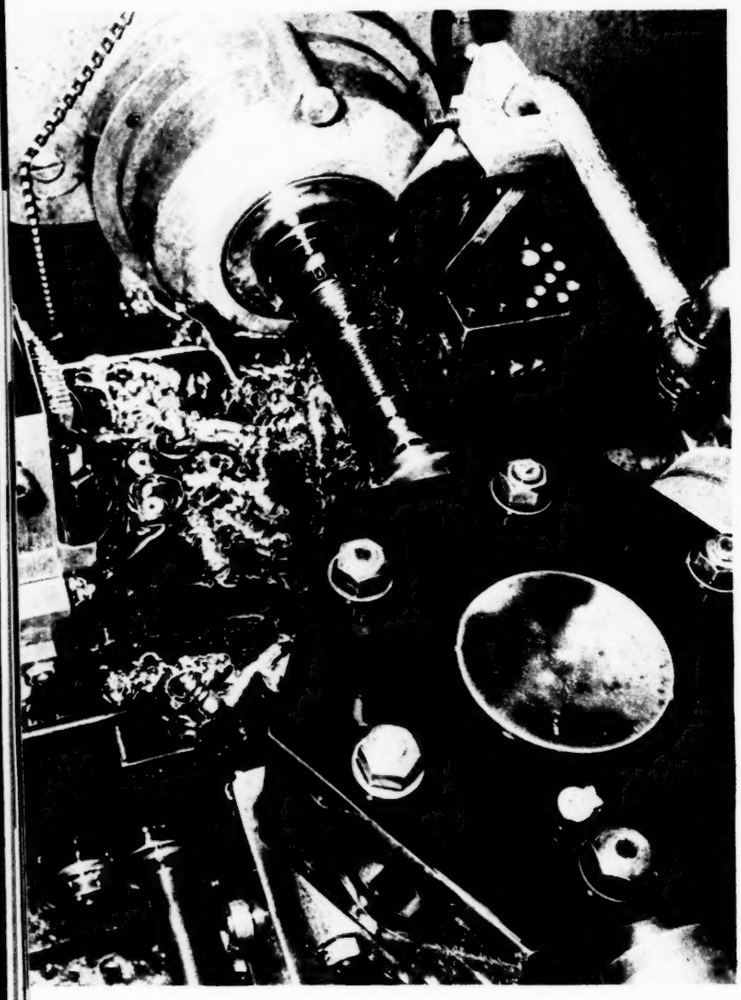


due to the great power required to provide air, particularly in cabin supercharged aircraft, some aircraft manufacturers are going to a 300F maximum.

Another consideration is the provision of sufficient air to prevent high cabin humidity. There are two important reasons for this requirement. First, low humidity makes the window defrosting and defogging requirement less critical; and second, maintenance of reasonable humidity prevents moisture condensation in compartment soundproofing or thermal installation. To illustrate the importance of the latter safeguard, the condensate in one airplane can weight as much as 200 pounds.

Still other air conditioning requirements are considered in aircraft design. Cabin cooling during some flight conditions is very desirable. For instance, while the cabin temperature should be maintained at 68F to 75F, outside air temperatures sometimes are as high as 110F to 120F at reasonable flying altitudes. Thus a cabin cooling temperature differential of 35F might easily be required. In addition, we can seriously look forward to refrigerated cargo aircraft for perishable cargoes. Also, cabin supercharged aircraft have a high cooling load due to the high air temperatures generated by the cabin blowers.

Up to the present time, aircraft manufacturers have not been able economically to incorporate refrigeration equipment in aircraft. Airlines provide ground conditioning equipment for summer operation. The cooling load in cabin supercharged air-



craft is handled by air-to-air aftercoolers using outside air as the coolant.

Deodorization, humidification and dehumidification are of considerable importance. Little has been done up to the present time to incorporate such items in aircraft, due largely to the weight of equipment involved.

In view of the requirements previously mentioned, the design of an aircraft cabin heating and ventilating system would follow this general sequence: the cabin heating temperature differential must be selected, compromise value of 115F often being used. Thus if we have an outside air temperature of —65F, the cabin temperature may be maintained at 50F, a cool but reasonably comfortable temperature.

The required ventilating rate must then be determined. A recommended value for human needs is 10 cfm per person of standard sea level air. In extreme cases where cabin humidity and cabin supercharging power loads are critical requirements, values as low as 5 cfm per person have been used. Entering air temperatures should be limited to 200F. If the ventilating rate is low, such temperatures may be maintained by installing recirculating heaters. Higher entering temperatures should be used only if the ventilating rate cannot be increased and recirculating heaters cannot be installed. The ventilating rate should be sufficiently high to maintain reasonably low humidities. This prevents condensation on the insulation, and in addition the window defogging and defrosting column is eased.

Next, cabin heat insulation must be selected. Critical criteria for selection are weight, thermal resistance, and soundproofing qualities. The best cabin heat insulation is the best compromise on these three items, with less important factors to be considered, including durability, installability, resistance to vibration, resistance to fire, moisture absorption, and resistance to vermin. The three materials generally used for insulation and soundproofing in present aircraft are kapok, glass wool, and mineral wool.

After the cabin heating temperature differential, cabin ventilating rate and cabin heat insulation are selected, the design cabin heat load may be determined. Heat transfer coefficients for various typical panels of the body must be calculated. Heat transfer loss, of course, is the product of these coefficients, the areas to which they apply, and the cabin heating temperature differential. Cabin ventilation loss is the product of the cabin ventilating rate, specific heat of air at constant pressure, the cabin heating temperature differential, and a factor for uncontrolled infiltration and exfiltration. The sum of these products less human load, electrical equipment load and cabin supercharging load will give the design cabin heat load.

The cabin heating design has now approached the point where selection of the cabin heating and ventilating equipment is necessary. At the present time aircraft heaters fall in two main classifications—those fired by aircraft engine fuel and those transferring heat from the exhaust gases.

In the latter classification, air, water (steam), or other liquid (glycol or similar chemicals) may be used as the fluid deriving heat from the exhaust gas. Gasoline fired and exhaust gas to air heat exchangers are now manufactured by many vendors.

The source of ventilating air must also be selected. Usual practice in aircraft is to use a leading edge inlet in the wing, nacelle or body, and exhaust the air though an atmospheric or negative pressure outlet. In more specialized cases fans or blowers are used. In the case of a recirculating heater installation, propeller type fans are generally used to carry the air through the heat exchangers. On cabin supercharged aircraft the cabin blowers are generally the source of cabin ventilating air.

To complete the cabin heating system the heating

and ventilating controls must be selected. The type of control may be either manual or automatic. The former type may be cable or push-pull rod controls, electric motorized controls with manual positioners, or hydraulic controls with manual levers. Automatic controls are either electric motorized controllers with bimetallic thermostats, or electronic controls.

Summarizing the cabin heating problem, the following general factors may be seen to affect the design of the system: weight, reliability, service requirements, comfort, and controllability.

These factors differ in importance for various types of aircraft. For example, a military airplane might require non-recirculating exhaust gas-to-air heat exchangers having manual control to give a low weight, very reliable system requiring minimum service. On the other hand, a commercial airliner might have a recirculating hot liquid system with automatic controls, giving maximum comfort and control at slightly greater weight, less reliability, and greater service requirements. The assumption is that the commercial operator must provide optimum comfort at the expense of necessity for skilled servicing, while the military operator must have optimum reliability with comparatively unskilled service at the expense of a slight reduction in comfort.

Window heating is generally considered an integral part of the cabin heating and ventilating problem. Of all methods which have been tested, the most practical general method of deicing exterior surfaces and defrosting or defogging interior surfaces is to supply heated air to the inner surface. Thus window heating ties in very closely with cabin heating and ventilating.

Heat requirements for exterior surface deicing vary from 1000 to 1500 Btu per hour per square foot of window area. For inside surface defogging and defrosting the basic design requirement is to maintain the surface temperature above the dew-point of the cabin air. In general the heat requirements for airplane window deicing, defrosting, and defogging are quite low in comparison to cabin heating requirements.

Regarding air flow requirements for exterior deicing, values of .75 to 1.5 pounds per minute per square foot of window are generally used. Inside defrosting and defogging requirements run a little lower, values being 0.5 to 1.0 pounds per minute per square foot of window surface. These values vary considerably, due to their dependence upon outside air temperature, speed of the airplane, location of the window on the airplane, expected cabin dew-point, and window thickness and material.

After selection of heat and air flows sufficient to care for the necessary window, the basic problem is to design an air duct system with sufficient capacity to carry the air to the desired outlet locations while providing minimized obstruction to view through the windows. The air outlets must be selected to suit the windows to be defrosted or deiced. Many types have been used. If the ducts can run under the windows, the slot type is generally used. This is the kind usually found on late model automobiles. Where ducts can only run to one corner of the window, the fan type is used to cover the window from that location. Another type finding favor due to its simplicity is the spray tube. This is a modification of a slot type having a series of drilled holes closely spaced on one side of the tube. A specialized outlet is the ejector type, which provides a mixed air temperature lower than that of the ventilating air supply. This type is used on aircraft having ventilating air supplied at temperatures too high for use on the windows.

To the heating and ventilating engineer, the aircraft industry offers a broad and promising field of endeavor. The unparalleled progress recorded by the airplane during the past decade, plus the promise which the future is believed to hold, combine to furnish a healthy stimulant to all lines of activity within the industry.

PLANE MODIFICATION

of Bechtel, McCone & Parsons uses non-metallic ductwork exclusively. Heating by 18 direct-fired systems with total capacity of 18,000,000 Btu per hr.

By R. M. RUSH
Manager, Industrial Dep't
Dravo Corporation
Pittsburgh, Pa.

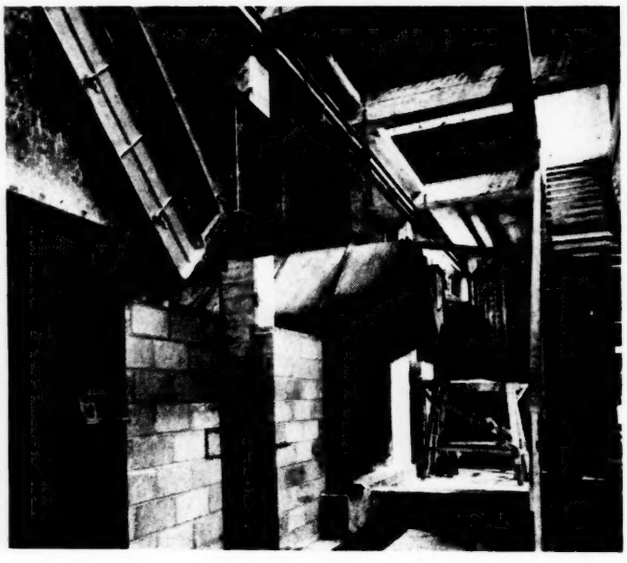
One of the country's largest direct-fired, forced air heating systems, setting a new standard in the heating of larger hangar areas, was recently installed in the airplane modification plant of Bechtel, McCone & Parsons, Birmingham, Ala. It is notable not only because of its size but because of the exclusive use of non-metallic ductwork and the heavy ventilating load carried.

The job covers about 35 acres under one roof. The windowless building, 720 by 1780 ft in plan, is divided into 10 hangars each 160 ft wide with three intervening service bays, one in the center of the building being 80 ft wide and the others 50 ft wide. These service bays have machine shops on the first floor and offices on the second.

The installation includes 18 Dravo direct-fired heaters with a total continuous rating of 108,000,000 Btu per hr, or 6,000,000 Btu per heater. Each heater is fed with a bin-feed coal stoker and equipped with a fan of 75,000 cfm, driven by a 60 hp motor. The heaters and appurtenances thereto are placed in batteries of three each in basements, about 50 feet square, at each end of each service bay. Thus there are six heater rooms in all, so placed as to make for the shortest runs of ductwork and for the most efficient handling of the heating and ventilating air.

Nearly 400,000 sq ft of ductwork are required on the job and in the hangars proper the ducts are run through the trusses or steel superstructure, 48 ft above the working space. One requirement of the specifications for this contract was that no heating equipment should occupy any hangar space below the roof trusses 40 ft above the floor. This was accomplished in a unique manner, by bringing the hot air at velocities of about 2,000 ft per minute, through round downcomers 8 ft long from the distributing ducts to Anemostats located at the level of the bottom of chord of the roof trusses. The warm air is evenly distributed from this height over the entire hangar floor.

View in one of the furnace rooms, showing front of three of heaters at left. Note stoker extension to central furnace, reaching the coal bin (not shown) at right.



In the service areas the machine shops on the lower floors are heated and ventilated with air distributed on both sides of the main ducts through Waterloo grilles, equipped with adjustable dampers and louvers. In the second floor offices, heat and ventilation is brought to the working spaces through split ducts, the smaller portion being for warm air in the Winter and the larger section for Summer ventilation. It is diffused through Anemostats. The heater fans are utilized to help carry the Summer ventilating load, which is large in this area, and in a building of this type where thousands of persons are employed. Otherwise, it would have been necessary to provide very large ventilating fans, which would have taken up valuable space as well as inviting the disapproval of the War Production Board on critical material requirements.

In addition to the heater room fans, several auxiliary fans are located in fan rooms at the ends of the office and machine bays. These fans are equipped with modulating dampers, so that air can be

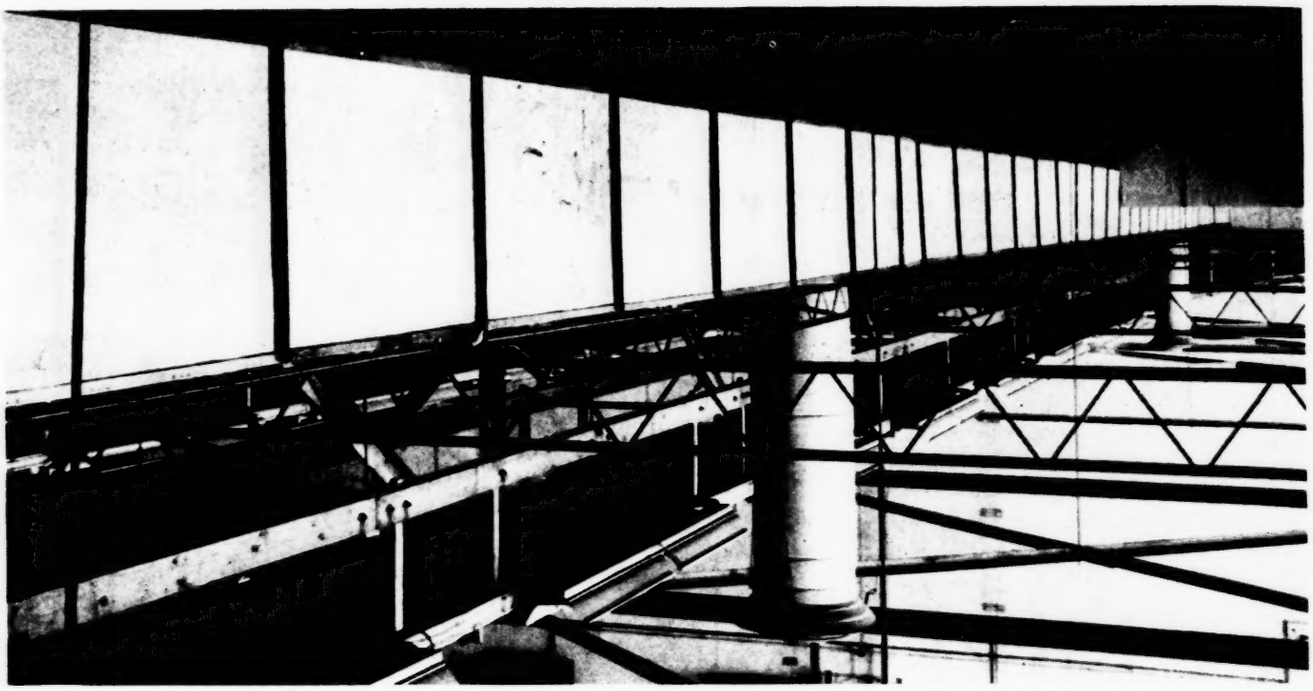
CENTER

taken from three sources. These are: first, outside air which comes from a large fresh air shaft to the roof and whose main function is to supply fresh air to the heater rooms; second, re-circulated air from the office or machine shop being heated, which returns through grilles; and third, warm air from the main warm air risers, which also supply the hangars. These modulating dampers are all under automatic control, except those from the fresh air shafts which can be set manually for any degree of fresh air circulation.

Within each fan room is a motor driven fan connected to the duct which supplies the adjacent office section or machine shop. In the offices provision is made for 10 air changes per hour for Summer ventilation and in the machine shops 4 changes per hour.

It should be noted that no moving parts are located outside the heater and fan rooms, and therefore the equipment is conveniently accessible for routine servicing and necessary maintenance.

The Dravo heaters are each rated at 6,000,000 Btu, plus a 20% overload for two hours when starting up. The heater room fans can take any amount of fresh air up to 100% capacity from large fresh air shafts approximately 10 x 17 feet in section, two to each heater room. These extend above the roof to small penthouses, equipped with Transite louvers. Air can be re-circulated or 100% fresh air drawn to the heater rooms. The heaters themselves are located in the same plenum chamber as the fans, so that all radiation from their outside surfaces and from the induced draft fans and breechings is recovered as useful heat.



View made from a catwalk showing a supply duct for one of the hangars. It is located 48 feet above the floor with the outlets extending down 8 feet lower. Note fire curtain in rear which seems to reduce size of duct.

A wall, flush with the front of the heater, separates the plenum chamber from the firing room, so that dirt from ashes or coal will not get into the heated air stream. The coal bunker is located below ground level, outside of the building, and the coal is fed with bin-feed Iron Fireman stokers directly from the bottom of the bunker to the hot air furnaces. The coal is dumped by gravity through manholes from the concrete roadway which forms the roof of the coal storage bunkers. This makes a very simple way to handle coal. Ashes are handled to ground level with motor-driven ash hoists. This arrangement of coal handling and ash handling makes it possible to handle the firing with a minimum of skilled labor.

The heating of the hangar areas is independent of the heating of the office and shop areas. The 220 volt control circuit of the three fans and stokers in each heater room is interlocked and operated as one. A "Summer-Winter" selector switch is located on the panel board in the firing area to permit easy transition from the Winter to the Summer cycle.

On the Winter cycle the heaters are controlled from any one of three sources; namely (1) Hangar return air bulb type thermostat located at the hangar return air grille; (2) Office room type thermostat located at the return air opening to the auxiliary fan room; (3) Shop room type thermostat located at the return air opening of the auxiliary fan room. The large fans of the heaters can be operated continuously or intermittently as desired.

One of the most interesting features of the whole installation is the non-metallic ductwork. Asbestos cement board of 3/16 and 1/4 inch thickness was used with the ducts being fabricated on the job. Authorities, charged with responsibility for this job, visited several installations to find what problems might be encountered in the erection of the non-

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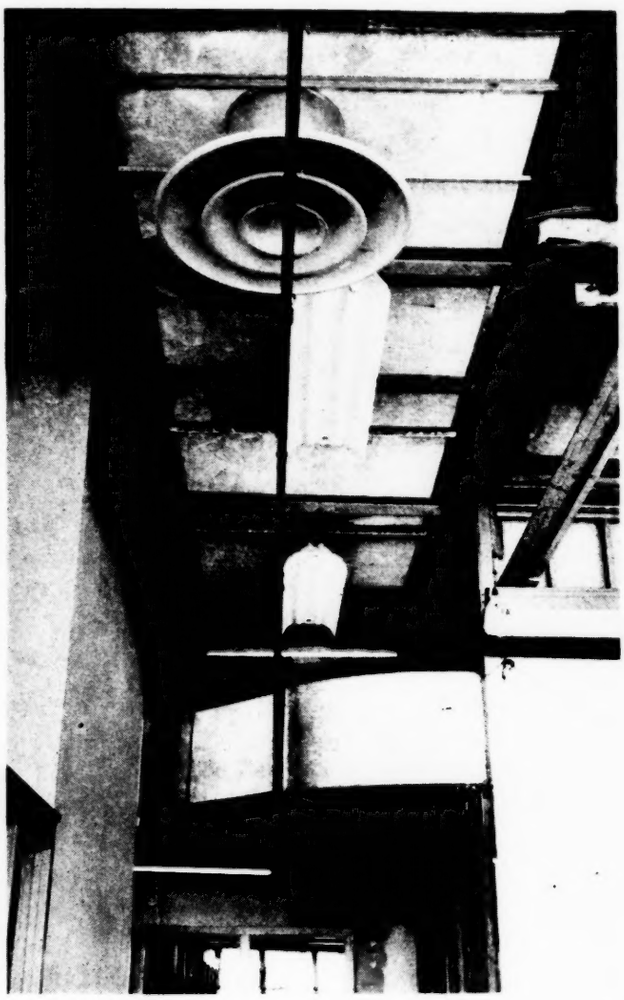
View in 80-foot service bay, showing ductwork.



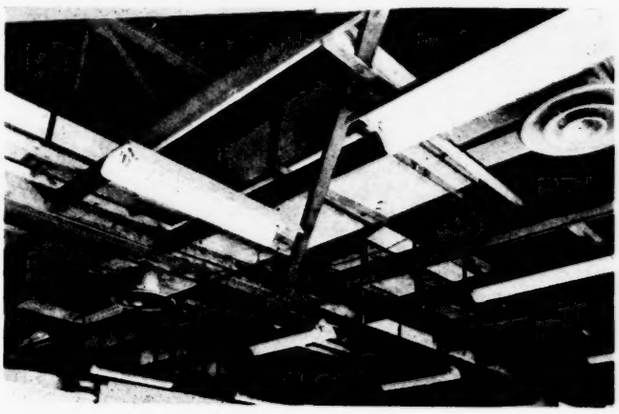
metallic ducts. It was found that one of the problems was to get a method of fastening the boards, so they would not get broken in making holes for sheet metal screws, etc., also a method of fastening which would prevent the asbestos board from being subjected to any strains after erection. The Lumm Panelled connector was decided upon, this type of installation being satisfactorily used at a large Army Depot in Toledo.

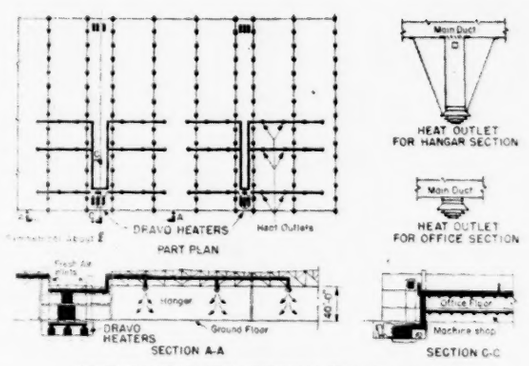
Briefly, this consists of frames or panels in which the non-metallic board is fastened by means of clips. These panels are riveted together to form a frame like a picture frame. Metallic clips are spot-welded to the frame to hold the asbestos board. The frames are made of 20 or 22 gauge material, so that the weight of the metal is low. The net result is that the sheet metal worker simply slips the proper size non-metallic board into the clips after riveting the frames into square sections four feet long. A reinforcing flange at each end of the four feet section bends over and locks with a flange on the next section, making a tight, leak-proof joint and extending around the four sides of the duct as a reinforcement every four feet. The joints are then caulked with plastic cement along the inside seams.

In this manner of fabrication the panel of non-metallic material is not drilled, nor is it under strain of any sort. It is free to expand or contract in its own section or framework. In this way a non-metallic ductwork job can be laid out carefully, like a pre-fabricated piping, each section marked for its proper place, and assembled with very little labor and very little danger of breakage. Other methods of fastening require careful handling, in spite of which some breakage occurs. Also other methods of fastening with corner angles require diagonal cross wires at each end of each section to hold it together, thus introducing more resistance to the flow of air in the ducts.

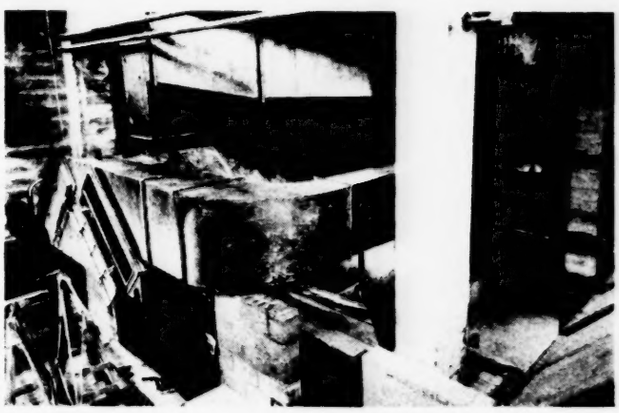
This tremendous heating and ventilating plant uses no valuable floor-space, the heaters and accessories being in the basement and the air distribution coming from above the bottom of the roof trusses. High overall efficiency is assured by reclaiming nearly all possible heat losses. A novel panel connector, for use with non-metallic board, prevents customary breakage and simplifies erection. All moving parts are located in rooms where they are readily accessible for service and maintenance. The use of war critical materials was kept at an exceptionally low quantity. In these respects, and from a general design standpoint, this large scale heating and ventilating project is a unique contribution in its field.

(Left) View in second floor office space showing duct work. Heating outlets at left and ventilating outlet at right. (Right) Workmen engaged in fabricating some of the cement asbestos board ducts.



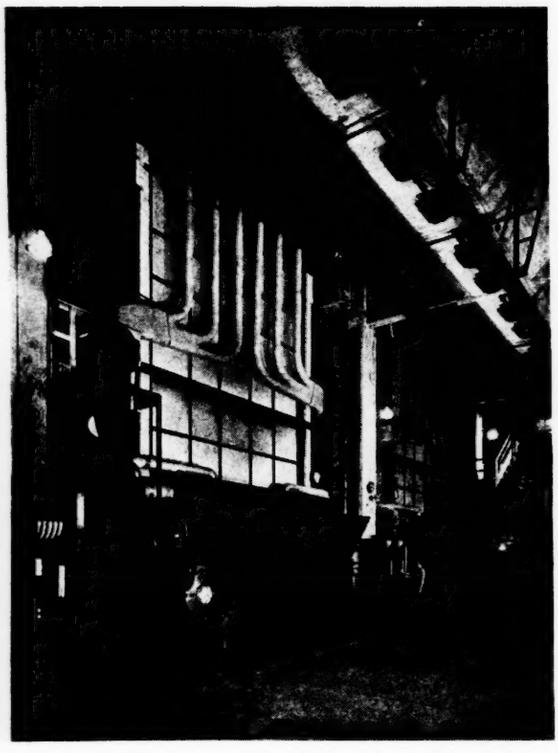


DRAVO HEATERS AND DUCT DISTRIBUTION FOR LARGE HANGAR



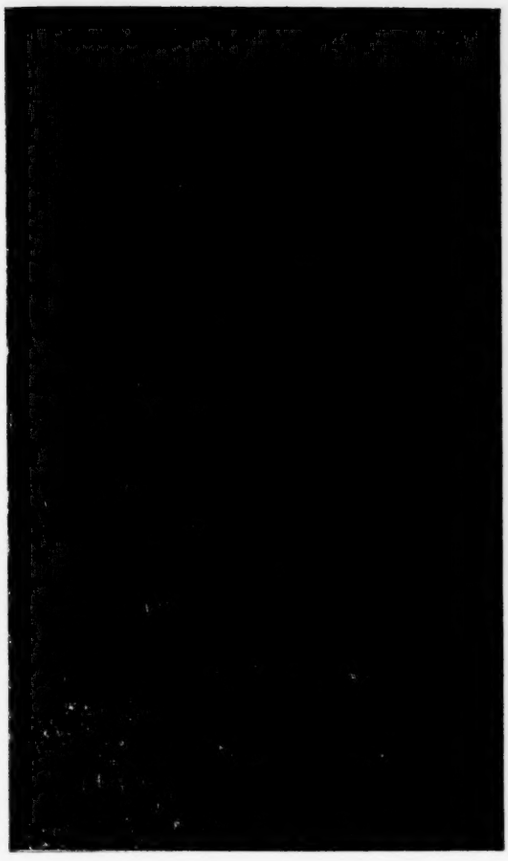
(Left) Plan drawing illustrating general characteristics of heating system. (Right) View from a high elevation, showing front of one of the furnaces, with smoke pipe and plenum above.

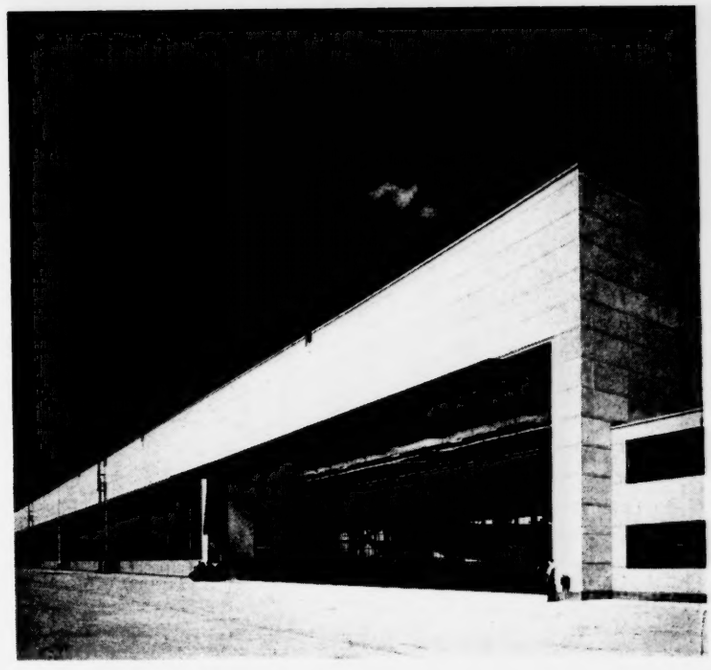
Ideal daylight working conditions exist in this all timber plant designed and built by The Austin Company for the Army at Chicago. Steam for heating, heating hot water, and domestic hot water as well as return piping is provided through piping located in a system of tunnels. The tunnels have small rooms for the pressure and reducing valve stations, and are ventilated to keep the temperature in the tunnel down. Vents from the tunnel are adjustable so that the air can be discharged outdoors or into the building.



(Left) Two of the B & W stoker-fed 120,000 lb. of steam per hr. boilers. Included in the power plant equipment are mechanically driven fans by Clarage & Coppus; two Bell & Gossett domestic water heaters to heat 300 gpm each from 40F to 180F and two hot water heaters to heat 350 gpm each from 175F to 215F.

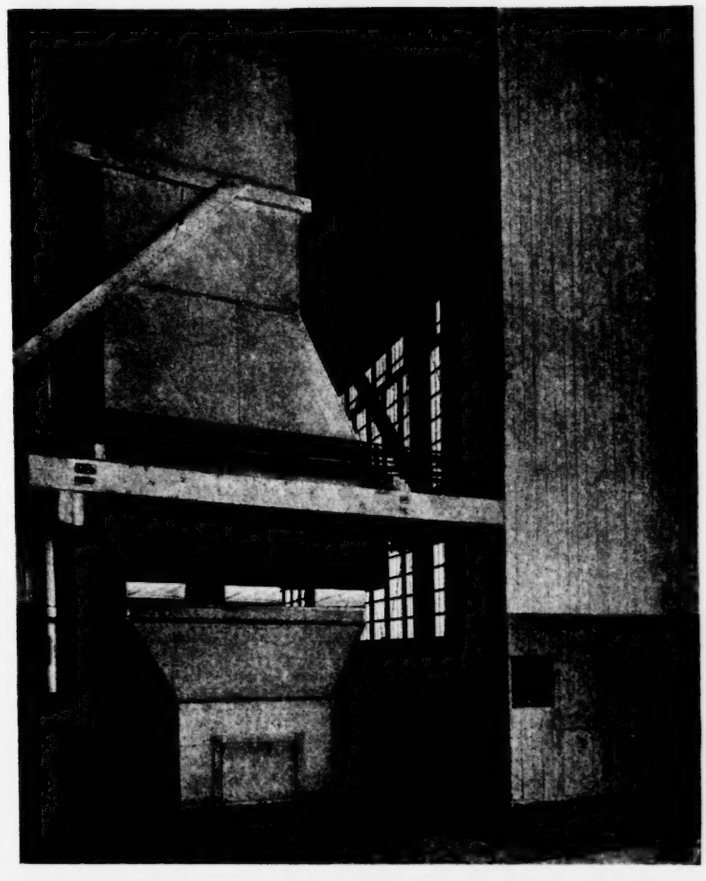
(Below) One end of the long all timber assembly plant. Process exhaust ventilating totals approximately 500,000 cfm.

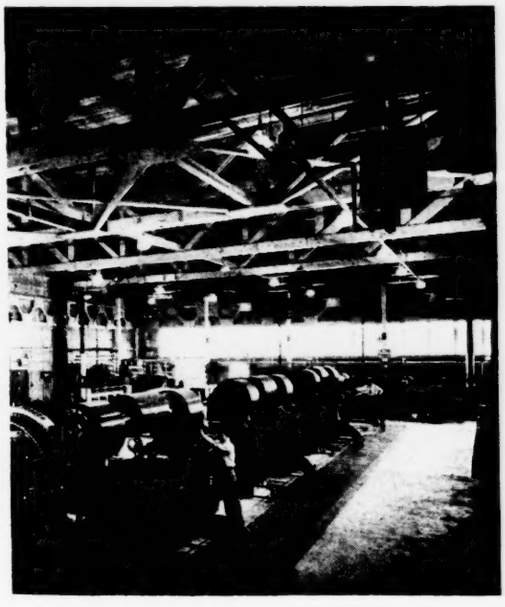




These doors have an area of 5,200 sq. ft. and the heating problem in connection with them was solved by the use of high velocity jets of hot air at the bottom of each door. The hot air is supplied from unit heaters as shown below. When one of the doors opens high velocity jets are automatically released. Air is supplied to the unit heaters from the upper portion of the hangar.

Some of the Ingersoll-Rand air compressors in the boiler house. Modine unit heaters can be seen overhead. Boiler house is primarily of timber construction and even the floor has wooden grilles in place of steel. The main building is heated with unit heaters each of which has a capacity of 600,000 Btu per hr. So as to reduce the weight of piping, the heating system in the main building is divided into 14 separate systems.





BARRAGE BALLOON

Plant makes use of second-hand steel frame; structure, completed in 55½ days, has heating and ventilating system designed for maximum efficiency with smallest amount of critical material.

By HENRY MAAG, Sales Dept.,
The H. K. Ferguson Co., and
L. G. GRIEBLING, Engineering Dept.,
Firestone Tire & Rubber Co.

LONG before our entry into World War II, the Firestone Tire and Rubber Company was breaking production records in their new war industry. Officials of that organization were taking the then National Defense contracts seriously and they wanted to waste no time in filling orders for the War Department.

They were interested in new methods, new techniques, new practices—if they contributed to getting the job done ahead of time; this is one of the reasons Firestone is now the owner of a steel frame structure which once housed exhibits in the Philadelphia Sesquicentennial Fair in 1927.

Firestone had just received a large contract from the Ordnance Department. Floor space was needed immediately. Materials were scarce and the production date could not stand any delay. Firestone officials called in representatives of The H. K. Ferguson Company, industrial engineers and builders of Cleveland and New York, and explained their problem. Ferguson engineers said they knew where sufficient steel to execute the job was available at once, provided Firestone would sanction the use of a second-hand steel frame. They agreed and the building was delivered to the owner after 55½ working days.

Much of that building is now devoted to the manufacture of barrage balloons. It is approximately 630 feet long and 325 feet wide, and contains 204,000 square feet of floor space. It has asbestos protected metal siding and steel sash walls, and a two-inch plank roof deck with a composition covering.

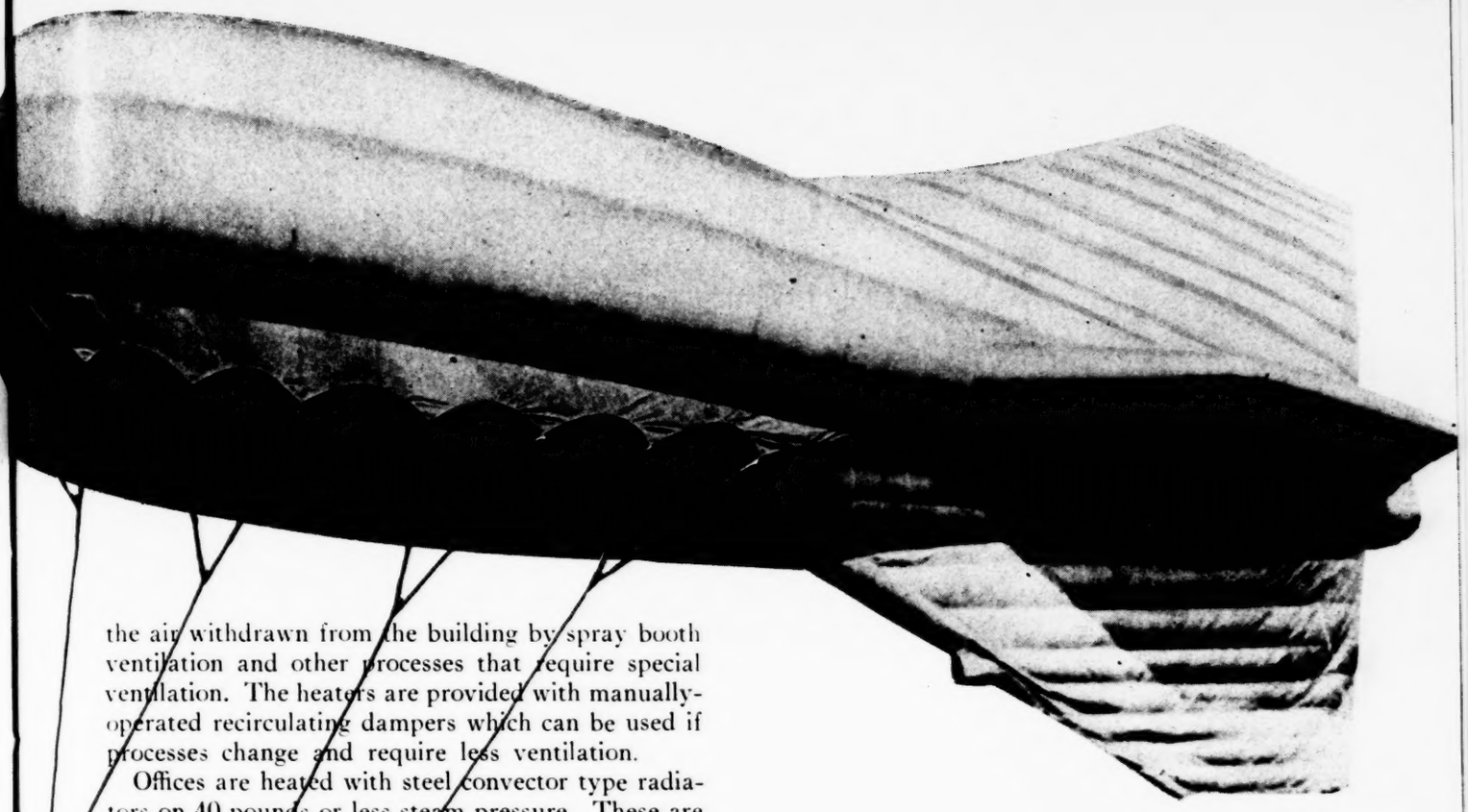
A second structure, similar in design, was built adjacent to the barrage balloon building to house production of other Firestone aviation products, among them wing assemblies. This building is 450 feet long and 375 feet wide, and contains 158,000 square feet of floor space.

The heating and ventilating systems for both structures were designed to obtain maximum efficiency with the smallest amount of critical materials. Firestone engineers also were interested in coordinating the system with the production processes at the plant.

In the aviation products building, steam is supplied at 180 lb pressure and is reduced to 40 lb or less for the heating system. The factory portion of the structure is heated by 31 projection type unit heaters and ten wall type heaters. All projection heaters, with the exception of two, are of single coil type and handle 9,000 cfm each. Some of the units are mounted 40 feet above the floor level and results have been satisfactory.

Two projection heaters have double coils and are used for cooling condensate. Each of the projection type heaters is equipped with a magnetic starter controlled by a room thermostat.

The ten wall type heaters are connected to outside air, each with a capacity of 15,000 cfm and equipped with face and by-pass dampers controlled from a room stat and a low limit stat. The 150,000 cfm of air supplied in this manner compensates for



the air withdrawn from the building by spray booth ventilation and other processes that require special ventilation. The heaters are provided with manually-operated recirculating dampers which can be used if processes change and require less ventilation.

Offices are heated with steel convector type radiators on 40 pounds or less steam pressure. These are equipped with small globe valves and traps discharge to sewer outlets so that there is little back pressure. In this way, some degree of control can be obtained by throttling the steam supply to individual radiators.

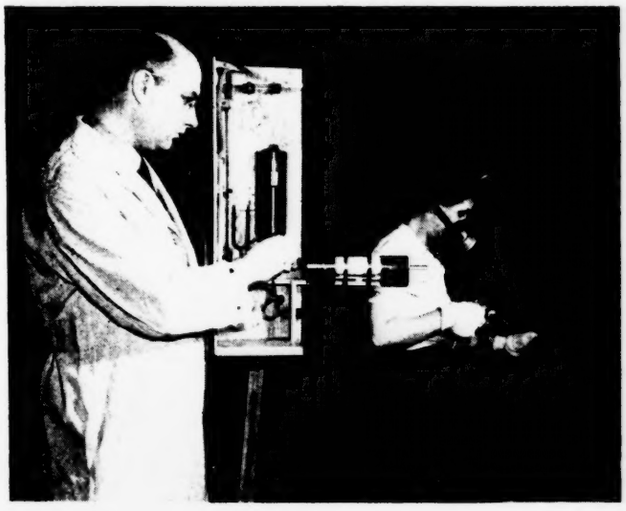
The mezzanine floor used for the store rooms is not partitioned off from the factory. The result is that the temperature on this floor rises because of the elevation. To solve this problem quickly and to conserve critical materials, six of the projection heaters were mounted on the roof to discharge fresh air through a short duct extending down through the roof with a suitable deflection on the bottom. A wood pent house was built on the roof over each of the heaters.

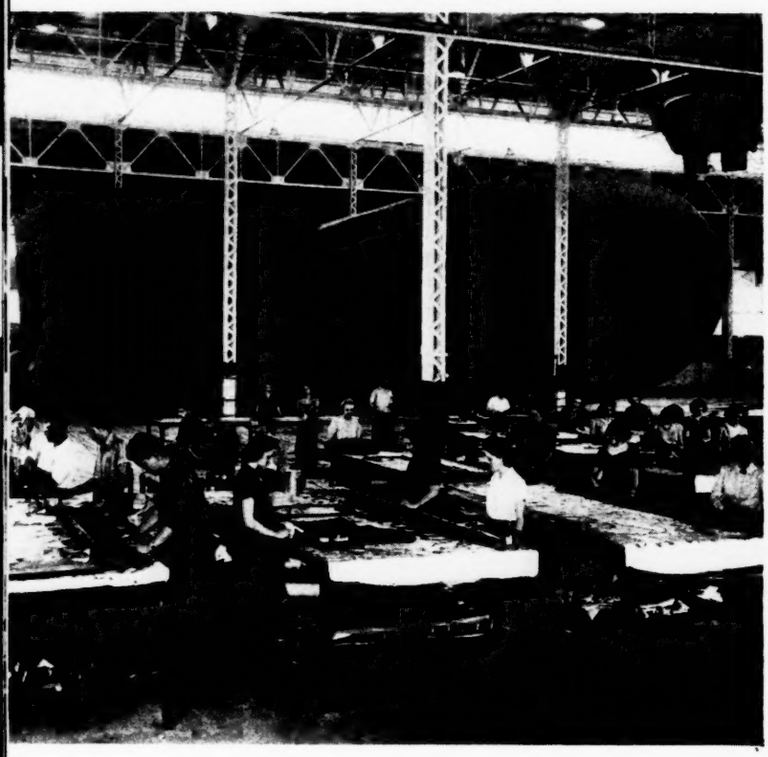
These six heaters supply 54,000 cfm of fresh air to the floor, thus bettering working conditions materially. In cold weather, they will again be restored to their place in the heating.

All condensate, with the exception of that from the office radiators, returns by gravity to another plant where it is used in process work.

The heating system for the building now used for the production of barrage balloons differs somewhat from that in the aviation products building. Steam is supplied at 180 lb pressure and is reduced

(Left) F. S. Mallette, Firestone Industrial hygienist, making a colorimetric analysis for organic solvent vapors in the paint compartment of the Firestone Aircraft Company. In the event that any operations are found to be injurious to the health of employees, Mr. Mallette recommends modern ventilation equipment as a preventive measure. The latest type of water spray paint booth ventilation is shown in the background. (Right) Exterior view of Firestone's Gun Mount Assembly Building.





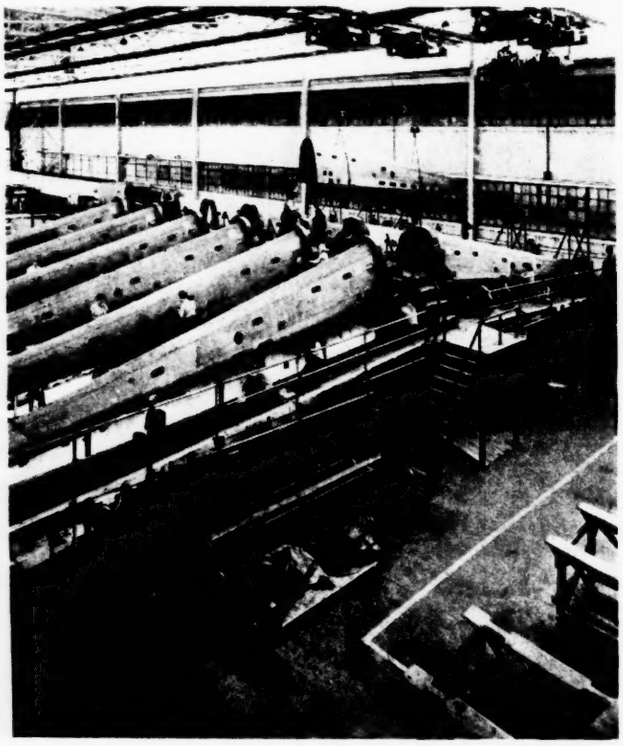
to 40 lb or less for the heating system, which consists of 25 inverted wall type heaters suspended from the ceiling and rated at 10,000 cfm each.

Because it is necessary for many employees to sit on the floor in the manufacture of the barrage balloons, additional heating and ventilating facilities were provided in that portion of the structure. Ten of the heaters were connected to fresh air inlets and equipped with face and by-pass dampers for temperature control. They remove 100,000 cfm from the department.

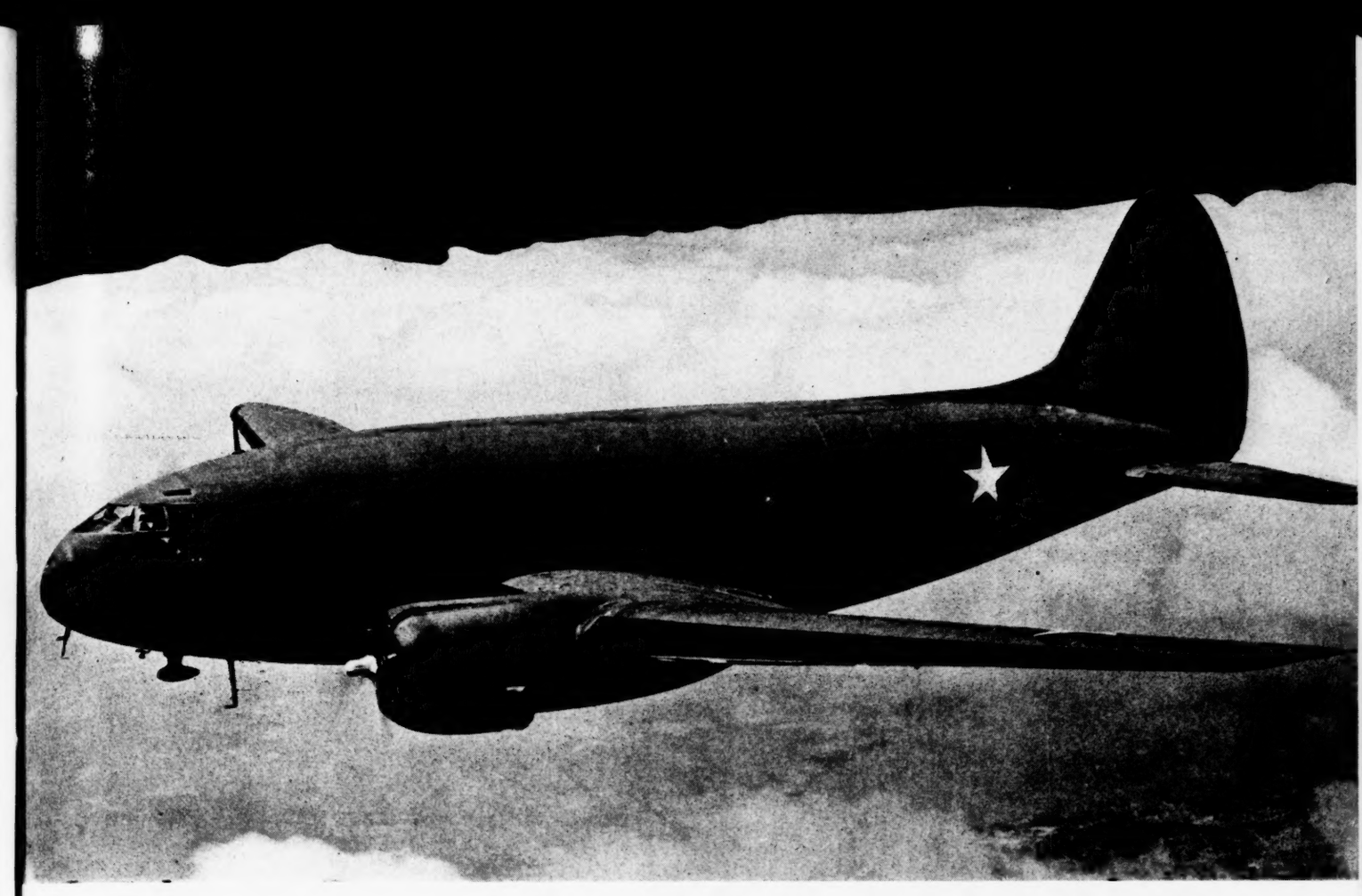
Pipe coil radiators were installed across the west end of the building. Projection type unit heaters of 9,000 cfm capacity were installed over the shipping and receiving doors, and several other projection heaters were installed throughout the building to meet local requirements.

Offices are heated by steel convector type radiators, while the large general offices are heated with projection heaters with multiple cone diffusers.

Mezzanine ventilation is handled in the same manner as in the aviation products building, and likewise all condensate from the factory section flows by gravity to other parts of the plant to be used in process work.



Interior view of Gun Mount Assembly Building.



ELECTRIC PROPELLERS

are made and assembled in windowless controlled atmosphere plant in Indiana; compressors driven by mixed pressure turbine to obtain better heat balance; non-metal supply ducts used throughout.

By R. A. ROTZ
Power Engineer
Curtiss-Wright Corp.,
Propeller Division
Indiana Plant

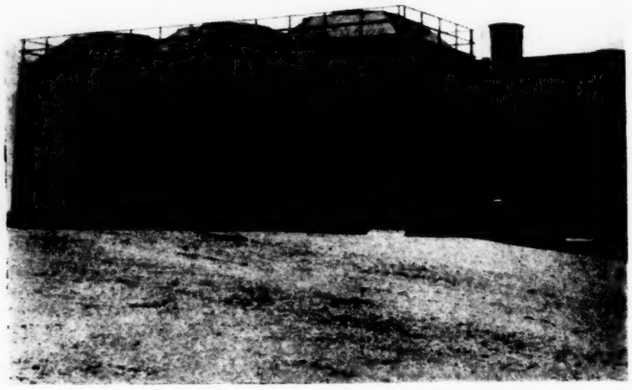
CONTROLLED atmosphere is playing an important role in the production of Curtiss Electric Propellers at the new Indiana Assembly Plant of the Curtiss-Wright Corporation, Propeller Division. This 450,000 sq ft building is operated in conjunction with existing manufacturing buildings, which have an area of approximately 757,000 sq ft, in which finished propeller parts are machined from raw materials.

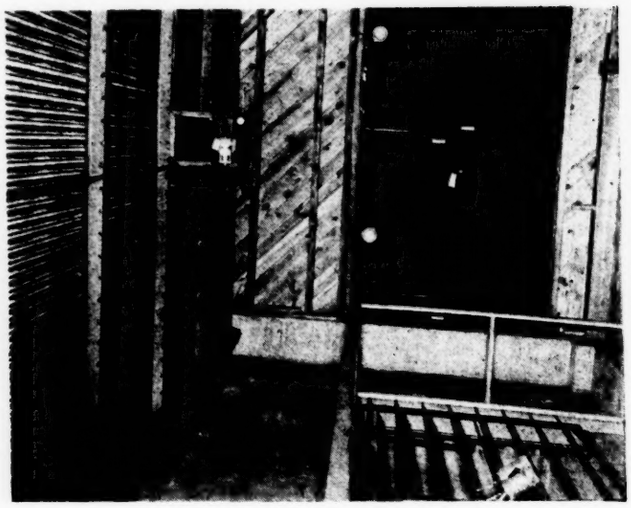
The construction of the Indiana assembly building was begun in March, 1942, after the government had placed restrictions on the use of air conditioning in plants in order to save critical materials. However, an exception was made in this case due to the fact that a controlled atmosphere was deemed necessary for the proper assembling of the manufactured parts with close tolerances and to prevent the possible rusting of the parts when handled in a territory in which the summer humidities frequently reach 80 to 85%. With this permission, a windowless plant having controlled atmosphere was designed, keeping in mind at all times the conservation of critical materials.

Circulated Water for Heating and Cooling

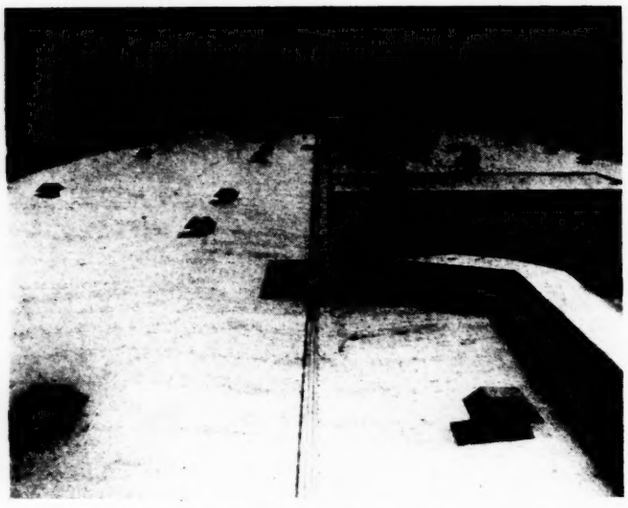
The winter heating and the summer cooling and dehumidification are incorporated into a single circulating water system from the power plant to the fan rooms. In the power plant the water is heated in winter in instananeous type heaters equipped with compensating control on the steam to the heaters, circulated to the fan rooms and returned again to the power plant for reheating.

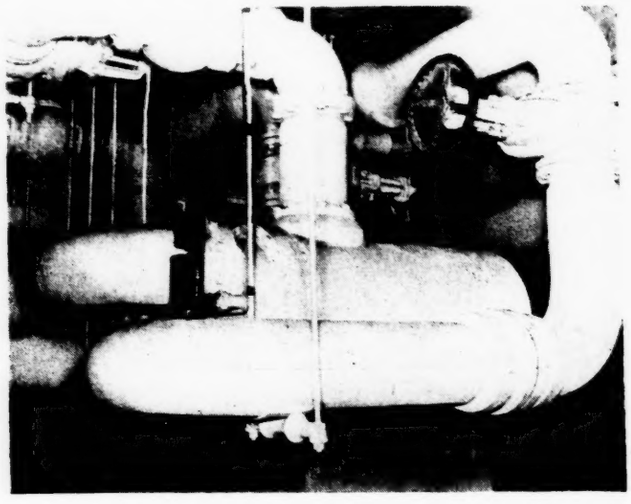
In the summer this same water is chilled in the power plant by the operation of a 1200-ton steam turbine driven centrifugal compressor with its condensers and evaporator, and circulated through the same system to the fan rooms.





(Left) The Water Cooling Equipment Corp. cooling tower on the roof of the power plant. (Right) A view of the entering air plenum, showing the relative position of the fresh and return air dampers with their Johnson Service controls, and the continuous oil bath filters.





(Left) Roof of the Assembly Building showing the fan rooms, part of supply duct work, and light-proof hooded exhaust ventilators. Aerovent fans automatically start and stop under the control of pressurestats operated by air pressure within the building. (Right) Patterson-Kelly instantaneous water heaters, equipped with Johnson Service compensating controls on the steam inlets, heat the circulating water in the winter.

Mixed Pressure Turbine Compressor

The compressor is driven by a steam turbine which is somewhat unique in its design due to the fact that it is a mixed pressure unit operating both on 190 lb and 30 lb steam. This unit was selected in order that a better heat balance might be obtained within the power plant itself by utilizing the exhaust from the turbine driven boiler fans and the air compressors to assist in the driving of the air conditioning compressor turbine. This power plant auxiliary equipment and the air compressors operate with an initial steam pressure of 190 lb per sq in. and exhaust at 30 lb. This 30 lb steam is then used, as mentioned above, in the summer for assisting in driving the air conditioning compressor turbine, and in the winter is used in the instantaneous heaters for heating the circulating water; it also is used the year round throughout the plant for process steam. Some 190 lb steam is also fed to the air conditioning compressor turbine. The feed is automatic and increases as the 30 lb steam is unable to maintain the necessary speed. Steam is also obtained from two 1,800 gpm turbine-driven cooling tower pumps and the 2,500 gpm turbine-driven circulating water pump.

The water is circulated from the power plant to the fan rooms in constant quantity with varying temperatures in the winter and a constant temperature of approximately 45F in the summer.

By-Pass Control

Temperature control is obtained by means of by-pass dampers around the coils. The by-pass dampers are actuated by thermostats in the return air ducts leading to the fan rooms. These dampers open with a rise in temperature in the winter and close with a rise in temperature in summer. The change in operation of the dampers is accomplished auto-

matically by the use of insertion stats in the circulating water system. When the water temperature is above 70F the damper control operates as a class I instrument; when it is below 70F the control operates as a class II instrument.

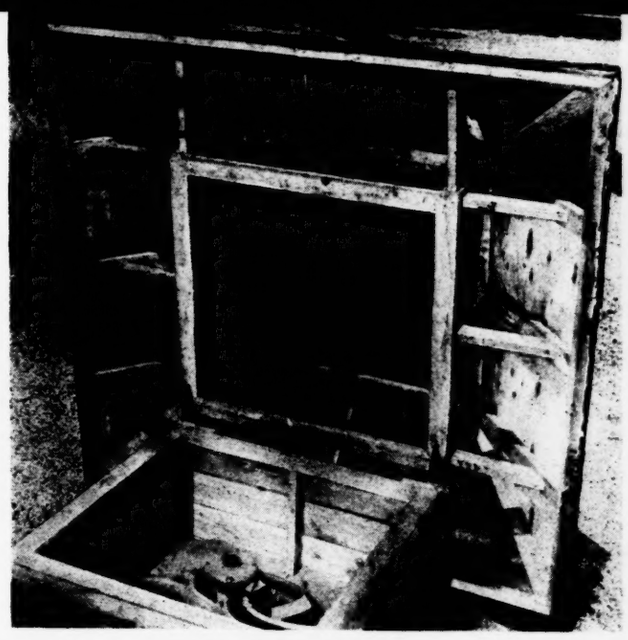
There are two large fan rooms supplying air to the main factory areas, each containing two 110,000 cfm fans. In addition to this, there are three smaller units serving the finished stores, inspection, cafeteria and testing areas. These units have a combined capacity of 103,000 cfm.

Exhaust Ventilation

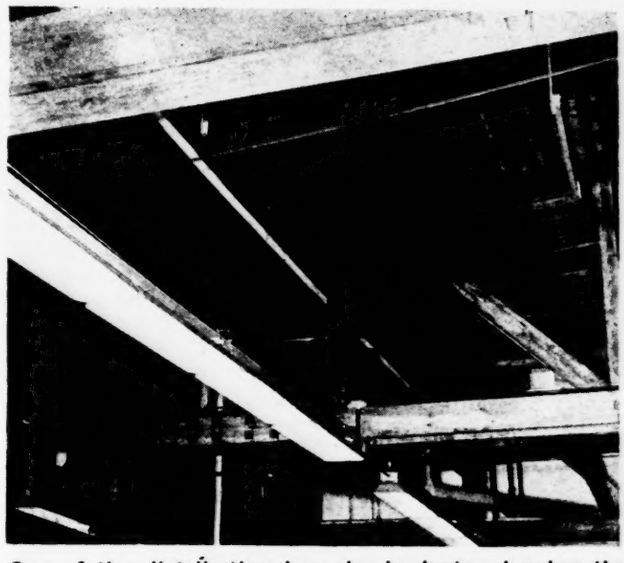
It was decided that there would be a distinct advantage in keeping the building at a pressure greater than that out-of-doors in order that the infiltration of dust and dirt could be kept at a minimum. This is accomplished by the use of roof ventilators controlled by pressure stats located within the building. The stats can be adjusted to maintain any differential between the inside and outside air pressures. These stats operate modulated dampers within the roof ventilators opening them with an increase in pressure inside the building and closing the dampers when an outside door is opened. The average position of the dampers in the roof ventilators varies with the amount of fresh air entering the systems.

An additional feature has been provided in the roof ventilators to take care of the condition when, even though the dampers are wide open, sufficient air is not being exhausted from the building. Under this condition, the fans in the roof ventilators are started automatically, providing a positive exhaust. Also, these fans may be started manually, providing a concentrated exhaust from any area that may be contaminated due to process work.

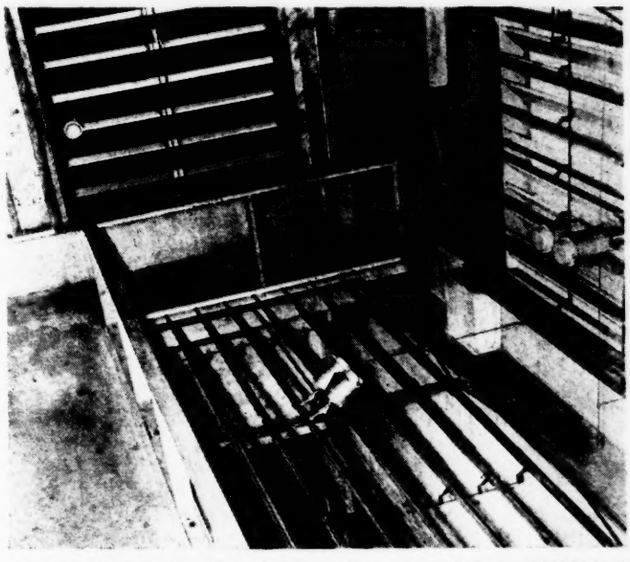
The amount of fresh air entering the system is controlled by entering air thermostats located in a mixture of the fresh and return air, and these thermostats are set to maintain a temperature of 50F in winter and 85F in summer.



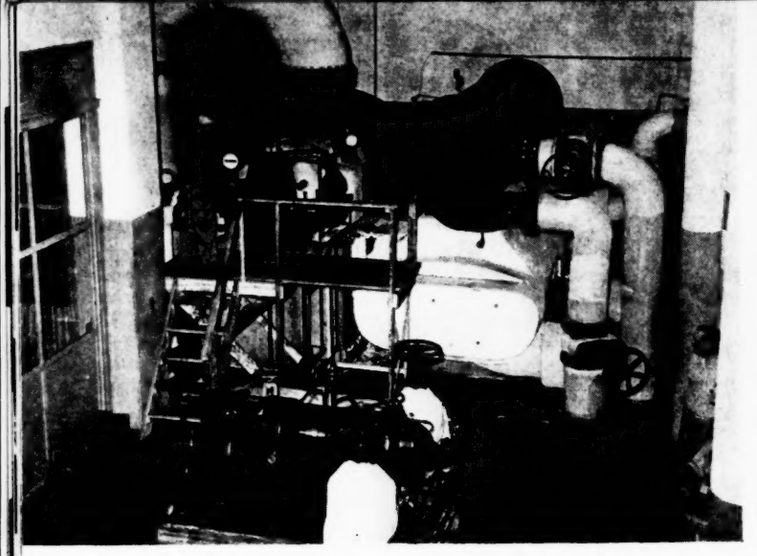
Typical exhaust ventilator with lid raised for servicing Aerovent direct-connected fan and motor unit. Note use of wood.

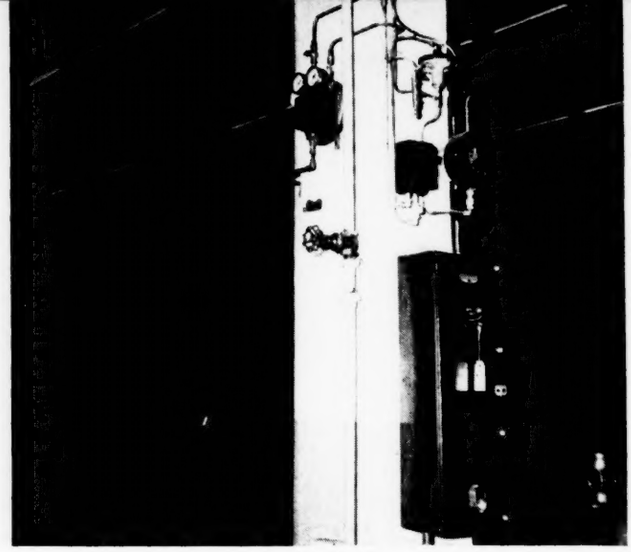


One of the distributing branch air ducts, showing the type of outlet used and the construction of the duct utilizing non-critical Masonite.



(Left) Entering air plenum for one of the 110,000 cfm fans, showing the relative position of the fresh air and return air dampers, operated by Johnson Service controls. (Right) One of the 110,000 cfm Sturtevant supply fans. Note the water piping to the coils which carry heated water in the winter and chilled water in summer.





(Left) Carrier air conditioning compressor, condenser, and water chiller. In the foreground is one of the Goulds' circulating water pumps. (Right) The roof exhaust ventilator control. Note the Johnson Service element for maintaining a differential of pressure between inside and outside and the Mercoid mercury switch for starting the fan when the dampers reach a wide open position.

Non-Metal Supply Ducts

In furtherance of the conservation of critical materials mentioned before, the roof of the building is held up by wooden trusses. These trusses, due to their having larger cross-sectional area than equivalent steel trusses, prevented the running of the main air ducts through the building above the truss line. In order to distribute the air, it was necessary that the main ducts be run along on the roof of the building. These main ducts are adequately insulated by the use of double thicknesses of exploded mica bonded sheets and corrugated asbestos. Extending down through the roof from the main ducts are vertical drops which lead into branch ducts running crosswise of the building. It is from these ducts that the air is finally admitted to the factory areas.

Again with the thought of critical material conservation, it was decided that the ducts should be made of Masonite, and in the main factory portion there are no grills on the duct outlets—only dampers being provided. It was felt that because these outlets are approximately 25 ft above the working area a conservation could again be obtained without too great a loss of efficiency by the omission of duct outlet distribution equipment. However, in the area where lower ceilings are encountered, side outlet grills were provided from the ducts.

Conditions Maintained

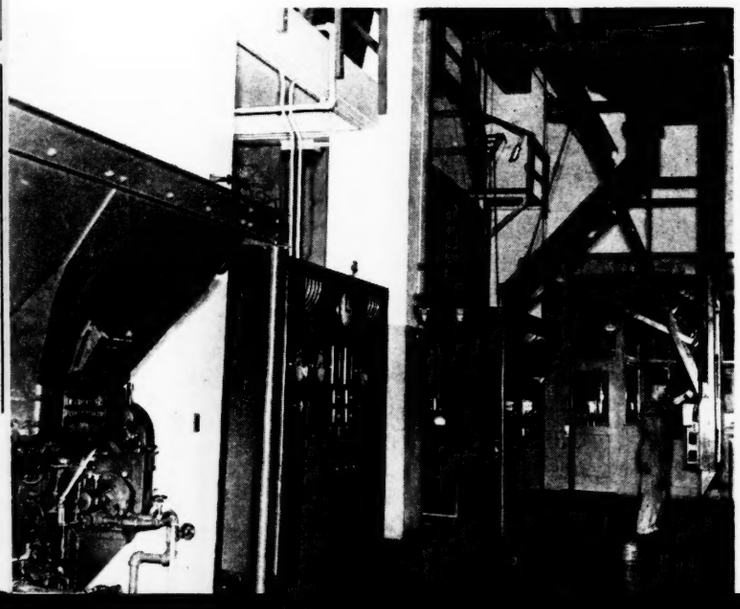
Although the system has never yet been operated on a permanent basis it has been designed to cool the air from 85F dry bulb and 69F wet bulb with chilled water entering at 48F and leaving at 60F. It is intended that this temperature air will provide a 15 degree differential between the inside and outside dry bulb temperatures and will maintain a relative humidity within the building of not to exceed 50%. In winter the same coils are intended to heat the air from 50F to 110F.

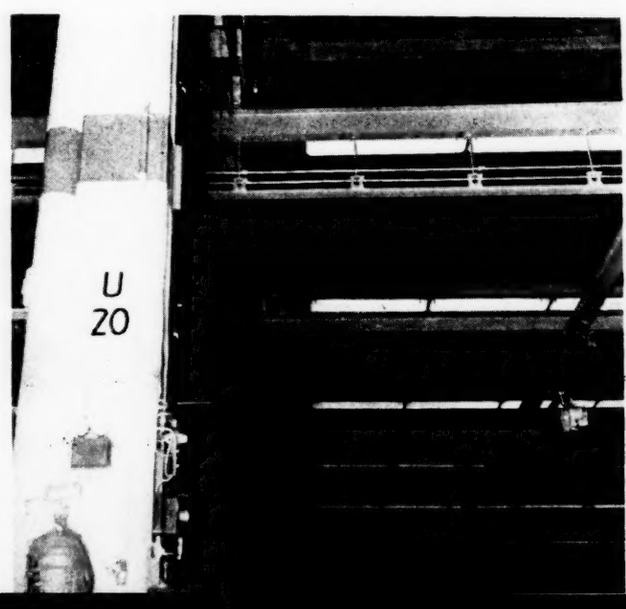
Although the plant was occupied in November, 1942, work was carried on until June, 1943, without atmosphere control due to failure to obtain delivery.

There is no doubt that controlled atmospheres in manufacturing buildings of the future will be of prime importance. The improvement in personnel efficiency as well as the reduction in the amount of necessary re-work, while difficult actually to measure and evaluate, are already established facts. Such atmospheric control also contributes greatly to the low cost of the goods produced and helps maintain the high standards of quality for which the United States is noted.

The project was designed by Albert Kahn Associated Architects and Engineers, Inc. Frank A. McBride was the piping contractor.

(Left) Main firing aisle in the power plant. Note the coal weigh lorry and the Detroit Stokers feed in the B & W boilers, which generate at 190 lb. per sq in. (Right) View from the floor showing the under side of the roof and one of the roof exhaust ventilators with Johnson Service modulating dampers, and louvers.





How to Design Exhaust Hoods

By J. M. DALLA VALLE

Engineer and Consultant,
Kruse Engineering Co.,
Newark, N. J.

Part 7—Hoods for Dust Control: Partial Enclosures, Miscellaneous

Granite Cutting

The introduction of pneumatic cutting tools has done much to increase the severity of dust exposure in the industries using them. This was the case in the granite industry, where hand pneumatic tools and pneumatic surfacing machines contribute the maximum dust concentrations.

Pneumatic hand tools in the granite industry are used for practically all detail work. The tools employed vary in size, depending on the type of work done. They are guided by hand over the stone surface and usually demand close attention of the operator, whose breathing level ranges from 6 to 15 in. above the tool. Under such conditions, it is difficult to control dust without causing some interference in the work performed. Hence, the hoods must be of a mobile type.

The surfacing machine is used for bringing the rough stone to a plane surface. The tools used in this machine are larger than the hand pneumatic type and are graded in size so as to bring the stone surface to any degree of smoothness. The tools are driven by a large pneumatic hammer attached to a horizontal beam which swings about a vertical column, which may be raised or lowered to accommodate stones of various sizes. The machine is heavily built and secured.

The basic fundamentals of hood design already presented are useful in assisting the engineer to estimate in advance the probable performance of an exhaust system. This has been done to a certain extent in the case of granite cutting. It has been found that, regardless of hood shape, approximately 200 feet of air per minute are required about the hand-operated tool in order to reduce the dust concentration at the worker's breathing level to an estimated safe limit of 10 million particles per cubic foot.[16] (See Part 3.) Figs. 51 to 53 show the velocity contours for three types of openings investigated for use with hand tools. It will be noted that in each of these figures the position of the tool lies near the 200 feet per minute contour, which is the velocity required for the control of the dust hazard. However, it is also evident that the air requirements for

[16]Hatch, Theodore; Drinker, Philip, and Choate, Sarah P., 1930. Control of the silicosis hazard in the hard rock industries. I. A laboratory study of the design of dust control systems for use with pneumatic granite cutting tools. Journal of Industrial Hygiene & Toxicology, 12:75-91.

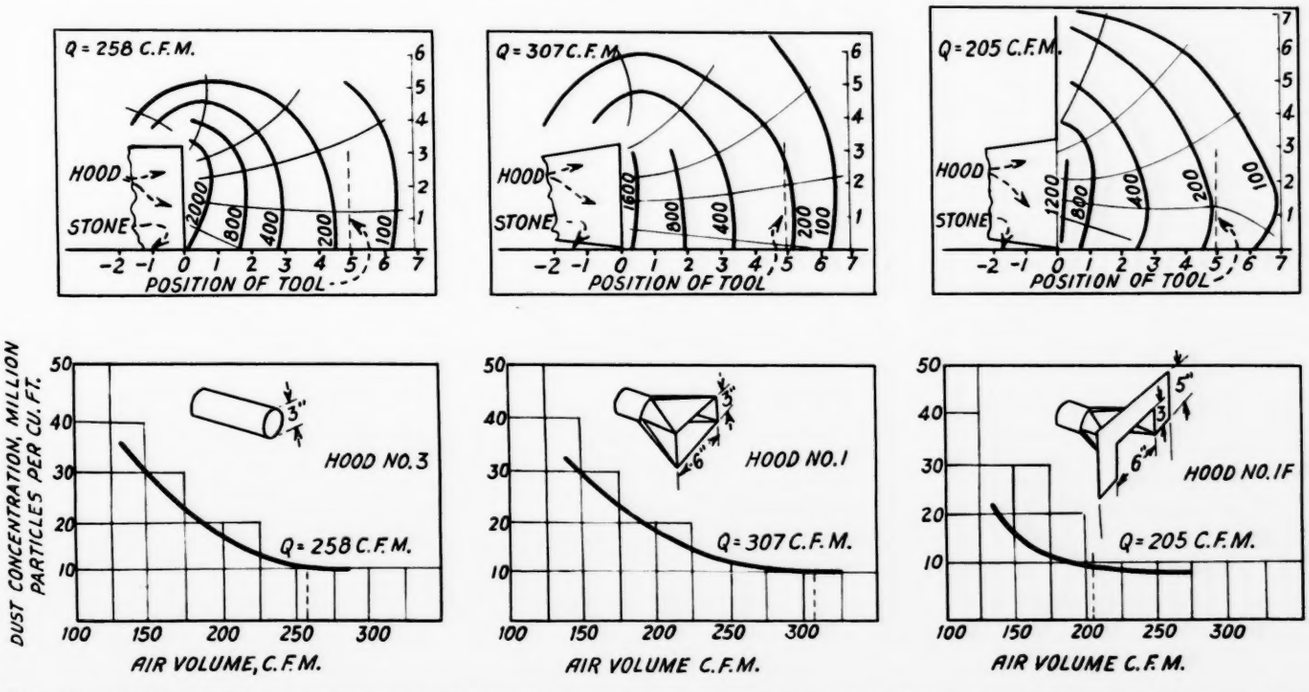


Fig. 51. (Left). Velocity contours and relation between air flow and dust counts for a 3-in. ordinary opening used for granite cutting. Fig. 52. (Center). Velocity contours and relation between air flow and dust counts for 3 x 6 in. ordinary opening used for granite cutting. Fig. 53. (Right). Velocity contours and relation between air flow and dust counts for a 3 x 6 in. flanged opening used for granite cutting.

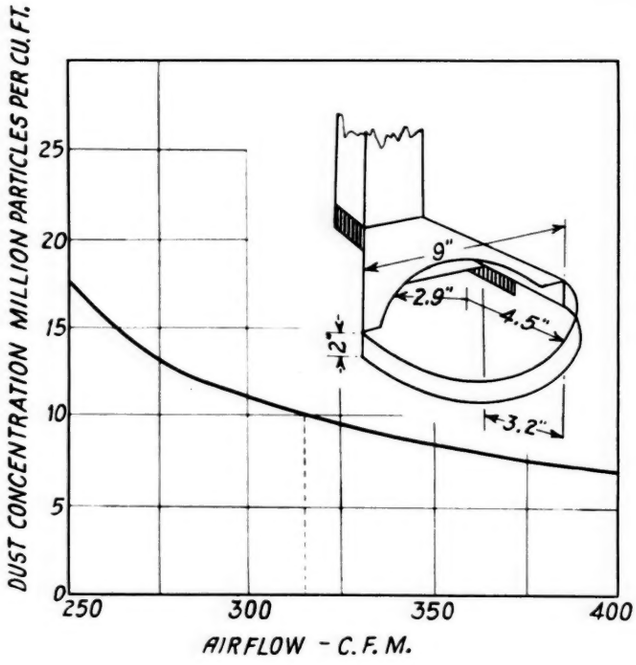
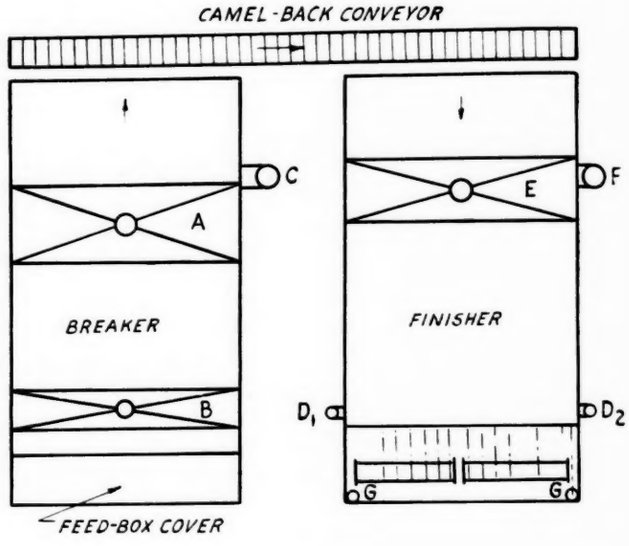


Fig. 54. (Left). Hood used for granite surfacing machine.
Fig. 55. (Below). Plan of enclosure used for asbestos carding machine.



each of the hood types vary considerably, as might be expected. The flow is a maximum for the 3 in. diameter circular duct end shown in Fig. 51, and a minimum for the rectangular 3x6 in. opening, using a flange as in Fig. 53. It is of interest to point out that the contours in Fig. 53, when expressed as percentages of the velocity at the opening, do not differ greatly from those shown for Case III, Fig. 27 (Part 3), which were determined by another method.

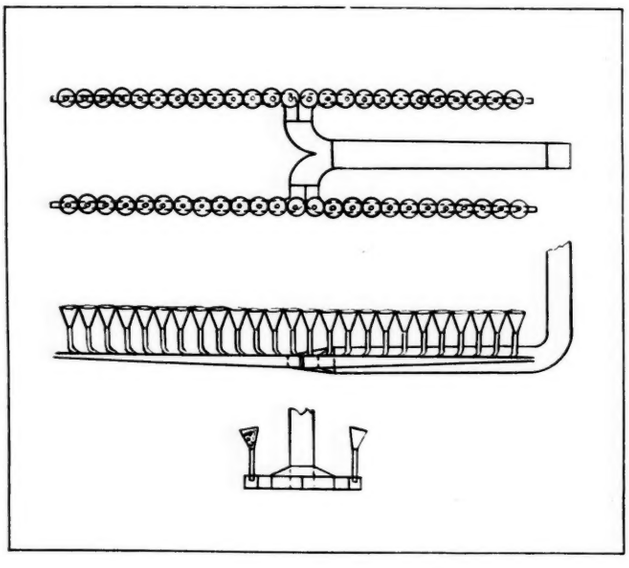
A hood has been developed which adequately controls the dust generated with a minimum amount of hindrance to the work and with low cost of operation. The hood designed is shown in Fig. 54. It comprises a rectangular opening with a semicircular barrier to limit the scattering of particles. With the tool in position within this barrier, a minimum flow of about 320 cfm of air is required to keep the dust concentration below 10 million particles per cubic foot, under normal conditions of operation. The hood is mounted on a carriage holding the cutting tool and connected by means of a flexible duct to an exhaust system. In this way, the hood constantly embraces the cutting tool as it moves over the stone surface.

Asbestos Carding

Another example of a partial enclosure is furnished by hoods used with asbestos carding machines.[17] These hoods must be located so that the air movement created does not remove the fine cotton and asbestos fiber from the revolving bristles. A system which has proved effective is shown in Fig. 55.

The top fly duct from the main carding cylinder

[17]Page, R. T., and Bloomfield, J. J., 1937. A study of dust control methods in an asbestos fabricating plant. Public Health Reports, 52:1713-1727.



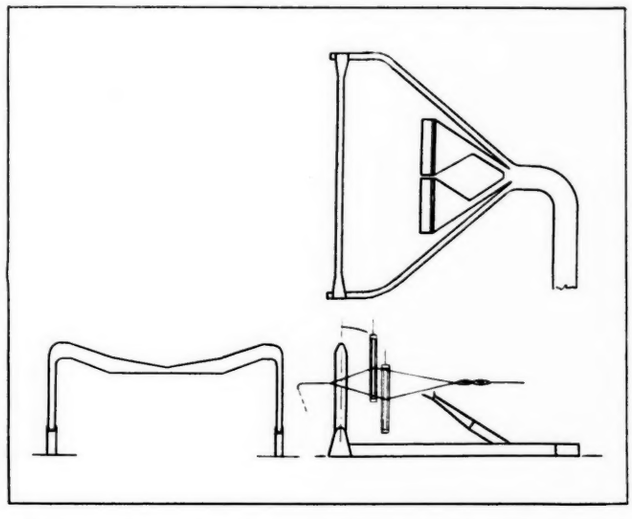


Fig. 56. (Left). Cup hoods used to control dust in winding asbestos yarn. Fig. 57. (Right). Hood attachments for asbestos cloth looms.

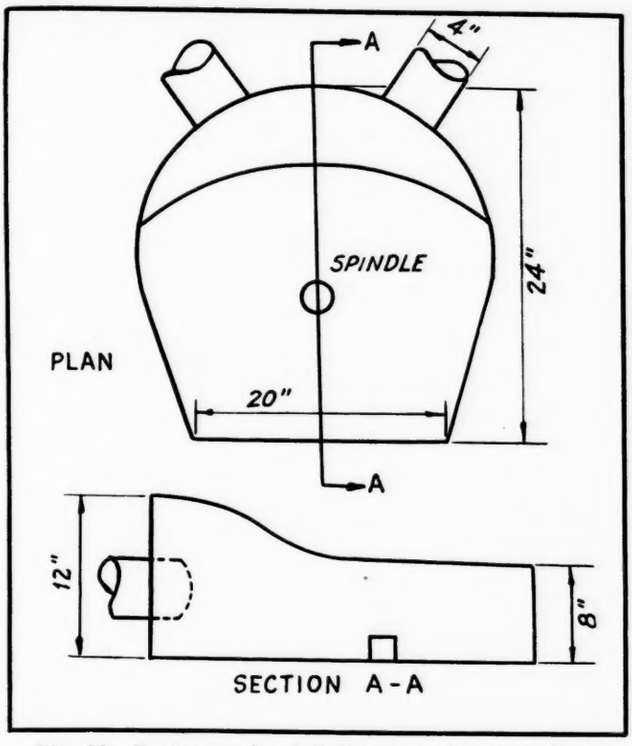


Fig. 58. Enclosure for felt hat pouncing operations.

is exhausted by Hood A, while Hood C exhausts the bottom fly, or settled dust below the carding cylinders. Each of these hoods must handle approximately 300 cubic feet of air. The breaker card is exhausted at these points. Hood B exhausts the space connecting the feed hopper and the machine proper. The hopper is enclosed, and about 160 cfm are exhausted.

The finishing card has four exhaust connections. Since both breaker and finisher cards are similar in most respects, Hoods E and F correspond to Hoods A and C. Both of these hoods handle about 300 cfm. The doffer card cylinders, doffer combs, and moving apron are exhausted from below, through Hoods D_1 and D_2. Branch ducts connected to the moving collectors G-G handle about 40 cfm each.

Duct sizes for these collectors may be based on velocities of approximately 2000 feet per minute.

TABLE 17.—AIR VOLUME REQUIREMENTS FOR CONVEYOR BELT TRANSFER POINTS.

Width of Belt, Inches	Air Volume, C.F.M.
Under 18	600
19-24	800
25-36	1200

Spool Winding of Asbestos Yarn

The dust produced by spooling operations on Foster winders can be controlled effectively by conical hoods in which each spool is placed.[18] These hoods handle approximately 50 cfm each. A typical layout of hooded spools is shown in Fig. 56.

Asbestos Cloth Weaving

The form of exhaust system used with looms weaving asbestos yarn is shown schematically in Fig. 57. A double hood exhausts air from under the warp, while a second hood (attached to the top of the loom lay) has ducts extending down each picker arm to an air-tight swing joint at the bottom. The openings on the upper hood consist of slots 9 in. long by 1 in. wide, extending 4 ft across the woven fabric at right angles to the arc. The average air volume handled by these hoods (both top and bottom) ranges from 600-1000 cfm.[19] The air volumes are about equally divided between the top and bottom hoods.

Felt Hat Pouncing

This is a manual process in which an operator applies a fine grade of sandpaper to a felt hat body fitted snugly over a block, revolving on a vertical shaft. This operation is productive of dust. A design which has proved effective in controlling the dust generated is presented in Fig. 58. Each opening shown exhausts approximately 300 cfm.

Conveying

Before hooding conveyor belts, every effort should be made to adjust the system so that overloading

[18]See footnote 17.
[19]See footnote 17.

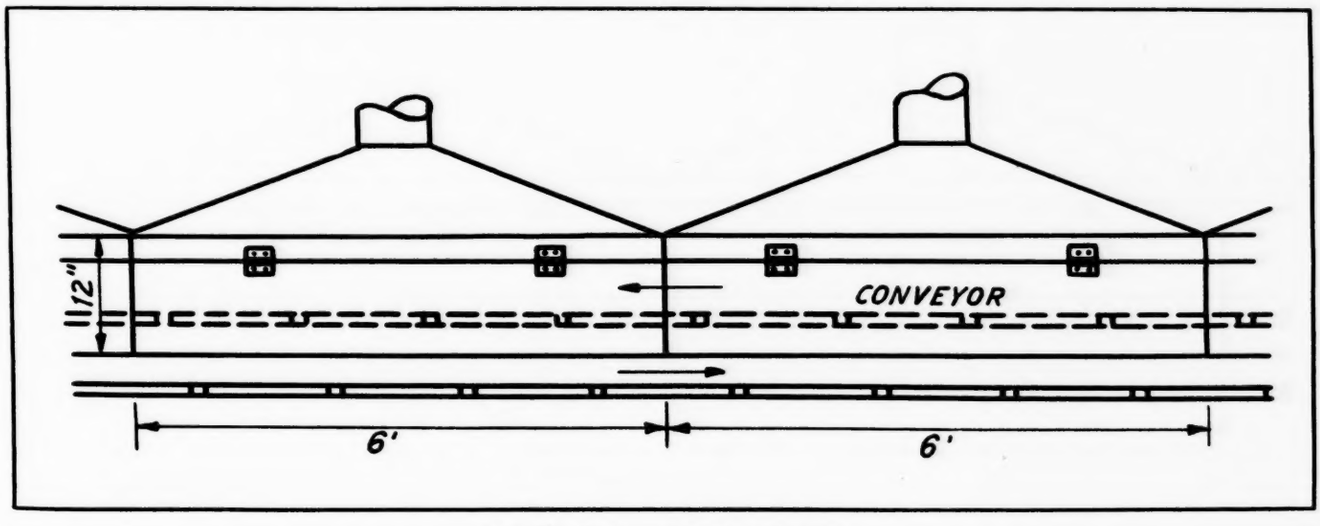


Fig. 59. Conveyor belt enclosure.

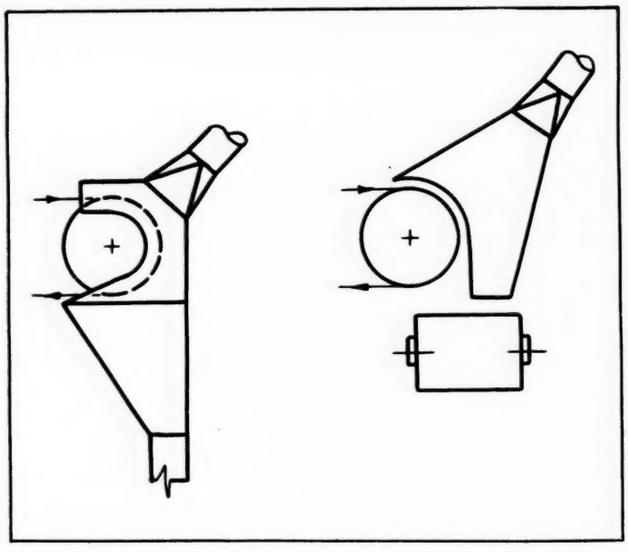


Fig. 60. Suggested hood types for conveyor dumping and transfer points.

(primary cause of dust production) may be avoided. Conveyor belts are difficult to exhaust effectively, unless completely enclosed.

In conveying hot materials, such as small parts casting, or permanent molds (after emptying), where the problem is one of nuisance elimination, a method similar to that shown in Fig. 59 may be used. The hoods should be sectioned, and equipped with hinged aprons extending below the level of the conveyor. Sections should not extend over 6 ft for 18- to 24-in. conveyor widths. Upward draft hoods used for the purpose described handle 100 cfm per square foot of conveyor surface. Duct velocities need not exceed 3000 feet per minute.

Where fine material is conveyed by means of a belt, and transferred either to another belt or to a hopper, hoods as shown schematically in Fig. 60 may be employed. At all transfer or dump points, the hood provided must handle large air volumes. The hoods must also provide easy accessibility for making repairs. Suitable air volumes for belts of various sizes are given in Table 17.

(Next month's article will discuss hoods for the control of fumes, mists, vapors and gases.)

Controlled Atmospheres Insure High-Quality "Sandwiches"

One of the most essential items in our U. S. war machine is a sandwich—one which is prepared and put together under scientifically controlled atmospheric conditions.

The sandwich isn't edible, because it comprises two layers of glass with a layer of plastic in between, a combination familiarly known as safety glass and used in planes, tanks, ships and transport vehicles.

Because it reacts sensitively to moisture and temperature, the unusual component of this sandwich, or plate, is the plastic interlayer, made by various companies including Monsanto Chemical Company at its Springfield, Mass., plant. This company found it imperative to carry on certain processing steps under constant conditions made possible only by air conditioning. Over a period of time, numerous problems have been solved through the installation of air conditioning and refrigeration equipment.

Typical is the area in which safety glass plastic is manufactured, where Carrier refrigeration machines used for air conditioning combine close process control with greater employee comfort and efficiency. Elsewhere in the plant, similar units are called upon to preserve finished plastic in useful saleable condition.

In all, seven installations by this same manufacturer have been made in the Monsanto Springfield plant since 1934. These include a centrifugal refrigeration machine, reciprocating refrigeration machines, silica gel dehydrators and ventilation equipment.

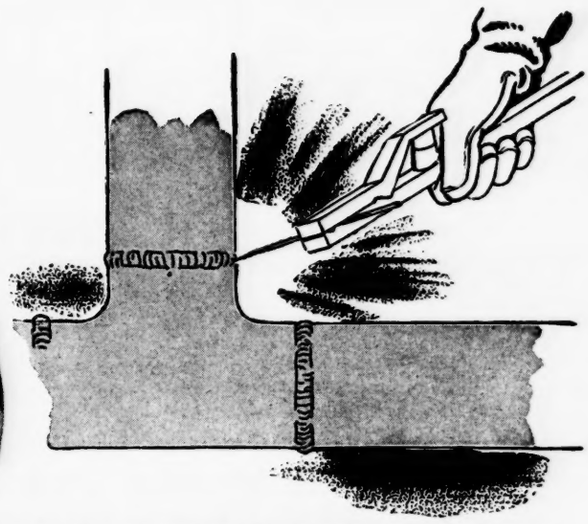
Monsanto's Plastics Division is one of the country's largest producers of plastics for safety glass.

Air Conditioned Mobile Division Active in Africa

A new type of mobile division, the first of its kind in existence, is in action somewhere in North Africa. It consists of only three trailers, but they are the first of their kind and promise to be models for an expanding fleet. One trailer is the mobile kitchen with refrigeration for food preservation and air conditioning for the eating quarters. Another is a sleeper trailer which is air conditioned. The third is a semi-trailer refrigerated and used for food storage. The fleet is for the accommodation of engineers and technicians constructing advance bases for troops under oppressive climatic conditions.

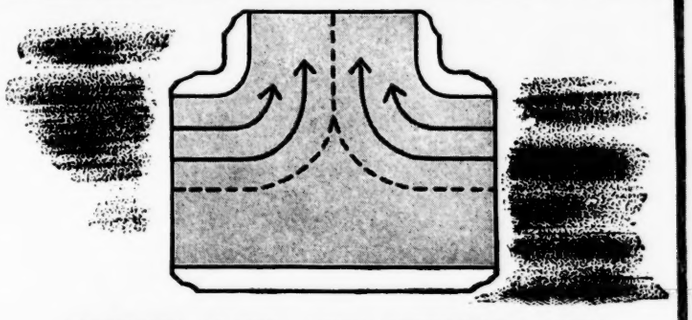
This mobile division was specially designed by Parkway Motors of Washington, incorporating Carrier air conditioning and refrigeration, and built in March, 1942, shipped to North Africa, and has been operating there since last June.

How TUBE-TURN welding tees improve piping construction



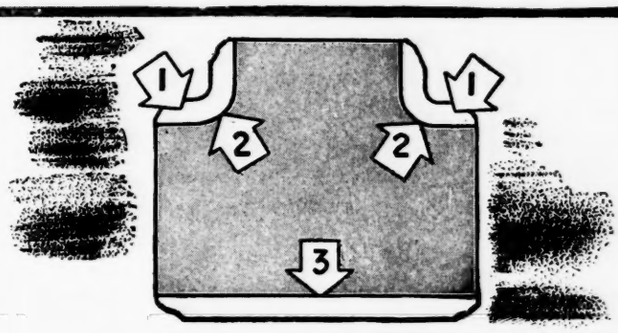
LONGER OUTLETS SPEED WELDING

More room for easier manipulation of rod means faster welding and better, sounder welds.



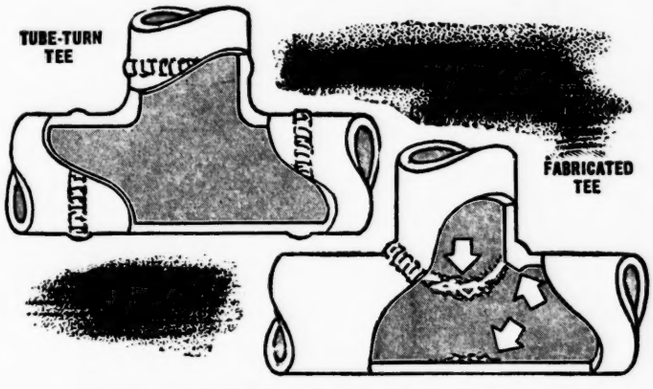
SMOOTH FLOW, LESS PRESSURE LOSS

Smooth inner walls assure even flow and reduce wear. Rounded inside crotch reduces pressure loss.



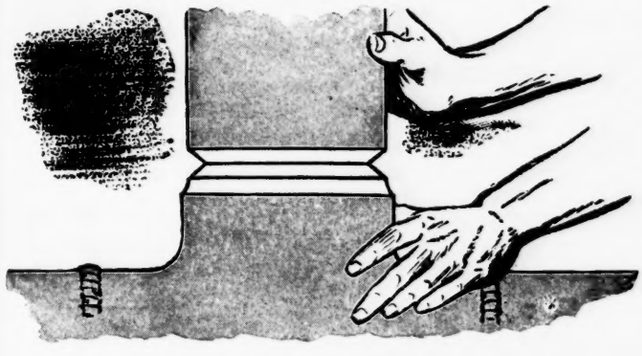
EXTRA STRENGTH AT STRAIN POINTS

Added thickness at top of run (1), crotch (2) and bottom (3) strengthens points of highest stress.



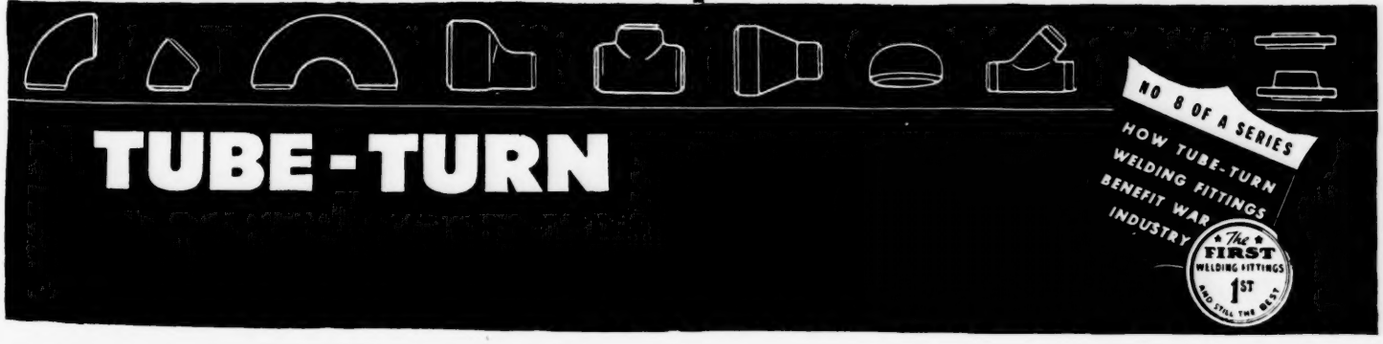
NO FABRICATION FAULTS

Fabricated tees often have jagged corners, crude welds, and slag. Tube-Turn Tees eliminate these.



FASTER, EASIER ALIGNING

Accurate bevels, plus I.D. and O.D. that exactly match the pipe, make aligning simple and speedy.


TUBE-TURN
NO 8 OF A SERIES
HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY
The FIRST WELDING FITTINGS 1ST AND STILL THE BEST

WASHINGTON NEWS

Summarized by Loring F. Overman. August Was Month of Paradoxes; WPB Heating Rulings Stiffened; Fuel Oil Situation Slightly Improved

As it affects the heating, ventilating and air conditioning industries, Washington's August was a month of paradoxes. Among them:

East Coast oil stocks dropped to 34.5% of normal for the week ending August 14—*yet* the "Big Inch" pipe line, in a test run, proved its ability to carry its planned peak of 325,000 barrels daily, and tank car deliveries for the week had climbed back up to 928,716 barrels daily, from a low of 845,964 during the week of July 31.

Fourth-quarter allotments of steel, 15,500,000 tons, were four million tons under requests from claimant agencies — *yet* the Office of Civilian Requirements announced plans to resume manufacture of many civilian items.

August reports of building totals for the first half of the year showed a drop of 23% under the volume for the same period of 1942—*yet* expansion of government-financed facilities, including both construction and equipment, was 20% higher.

The stockpile of synthetic rubber showed marked gains — *yet* the supply of new tires for all except the top priority'd trucks remained woefully short of requirements.

All in all, however, August happenings in Washington, left the impression that despite the continuance of numerous difficult cross-currents, a tide of purpose is flowing more steadily than ever before. Perhaps the conclusion is sparked by encouraging news from the fighting fronts. In any event, there was more news of progress within the alphabetical bureaus; less of the type that once appeared merely to lead to some enigmatic new jumping-off place.

P-84 and L-79 Revised

The WPB Plumbing and Heating Division, after months of consideration and re-writing, came out on August 23 with two amended Orders that have been eagerly awaited by the trade.

The general revision of Plumbing and Heating Equipment Order L-79 does not relax restrictions on plumbing and heating requirements, but it provides for more efficient distribution. This is accomplished by restricting sale or delivery of plumbing and heating equipment, as defined in the order, from the manufacturing level down to the ultimate consumer, to rated orders of A-10 or higher. Previous restrictions required an A-10 or higher rating only to cover sales to the ultimate consumer. This resulted, it was claimed, in an uneven distribution of existing equipment to the various wholesale and retail outlets.

The revised order extends restrictions to cover all except non-metallic plumbing and heating equipment. Formerly, only equipment containing 50% or more metal by weight was included under restrictions of the order. All items of metal plumbing and heating equipment which cost the purchaser less than $5.00 are exempted from the restrictions. Previously the order specified that items costing less than $5 could be sold without ratings provided such sales were part of an order totalling no more than $10.

"Heating equipment", as defined in the Order, "means any material, device or apparatus, including component parts thereof, used as a unit or included in a system designed for generating, conveying, circulating, distributing, transferring, or controlling heat, and designed for, but not necessarily limited to, heating air spaces or controlling temperature within building or other structures, excluding ships.

"It shall not include critical heat exchangers as defined in Order L-172, fans and blowers as defined in L-280, equipment designed primarily for refrigeration and dehumidification as defined in L-38, steel power boilers of the types defined in L-117, steel boilers designed for locomotive or for marine shipboard use, equipment exterior to a building which is heated by steam or hot water distributed from a central source for general use as a public utility, equipment using electricity as a fuel, or equipment designed for heating aircraft or automotive or railroad vehicles, but it shall include trailer and caboose stoves."

P-84 Rates Repairs AA-5

Preference ratings assigned for repair and replacement of plumbing and heating equipment was raised to AA-5 from AA-10 by issuance of Amended Order P-84. The revised order requires the ultimate consumer to sign a certification of need when purchasing plumbing and heating repair or replacement parts or equipment costing more than $5. Previous restrictions required certification only when cost of equipment was $50 or more. Any person making sales of items costing less than $5 may use the AA-5 rating to replace his stock.

Under the amended order the AA-5 rating may be used by a consumer to purchase parts or equipment (other than stokers) to convert oil-burning or gas-burning equipment to solid fuel burning equipment. Definitions of heating equipment, as given in P-84 are identical with those in Order L-79.

The order includes the following provision:

"Ratings assigned by this order are to be used only to obtain materials, equipment or parts needed in replacements of plumbing or heating equipment worn out, damaged beyond repair, or destroyed, or to repair such equipment because of actual breakdown, or for conversion parts. They may not be used to replace usable equipment or to make a substitution which would provide more extensive facilities than are necessary to replace the equipment, part or parts worn out, damaged or destroyed."

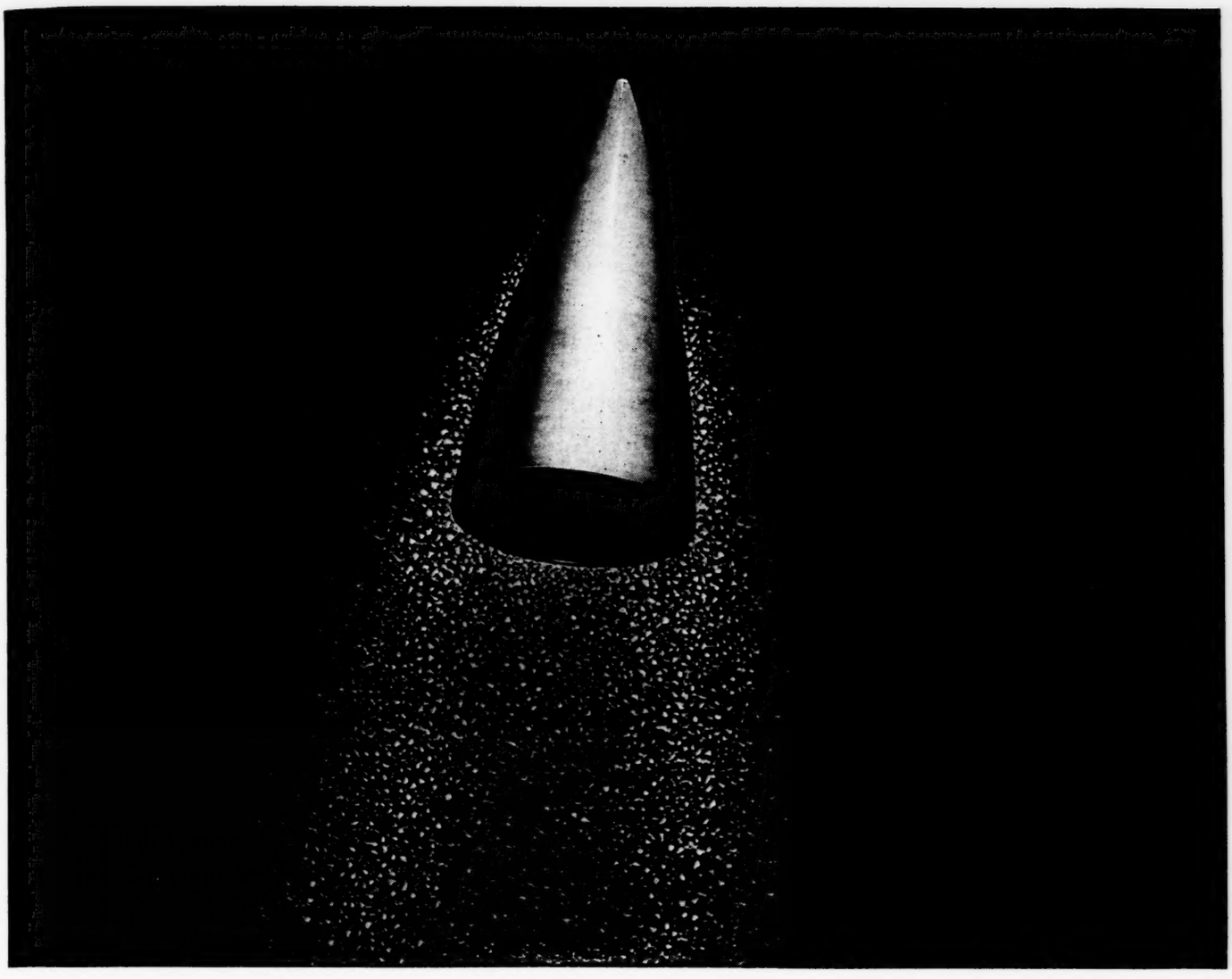
A certification signed by the purchaser is all that is needed to apply the rating. A further provision of the order requires that persons making the repairs or replacement must, within 30 days, turn in to authorized metal scrap dealers, all replaced metallic parts or equipment which is not coated with a fused or non-metallic surface.

Oil Situation Improves

Although military needs and the over-enthusiasm of motorists continue to keep East Coast oil reserve stocks at a point approximately one-third of normal, the overall picture is said to be meeting the approval of those responsible for long-range planning.

For the month of September, the Office of the Petroleum Administration has authorized oil production at a rate of 4,552,100 barrels daily—458,900 barrels higher than actual production during September of 1942, and 127,500 barrels higher than amounts certified for production in August of this year.

This authorization implies a vast improvement in the petroleum transportation picture, permitting the announcement of two plans designed to



Windshields for shells

Here is a photograph of a 75 mm. shell windshield. It is hollow, and is tightly fastened over the blunt nose of the shell body. Projectiles of heavier types are fitted with windshields which streamline them in flight, shatter like eggshells upon impact, and let the "business end" of the shell get in its work.

The remarkable thing about this shell windshield is that it is deep-drawn from a single flat piece of sheet steel. Only steel of exceptional deep-drawing quality can stand up to this drastic cold work.

When you multiply this one windshield by the millions—yes, millions—that will be needed for big and little guns before the war is won, the substantial tonnage of quality steel required is apparent. Bethlehem Steel Company is supplying in large tonnages the special sheet steel required for shell windshields, as well as sheet steel for bomb fins, tanks, trucks, jeeps, and scores of other vital applications in the fighting zones and on the home front.

★ ★ ★ ★ ★ ★ ★ ★

BETHLEHEM STEEL

anticipate next winter's problems of fuel oil as well as those using petroleum for non-heating purposes.

Fuel Oil Boost Asked

The first of these plans, announced August 9, requested East Coast refiners to increase their production of home-heating oil and 80-octane all-purpose military gasoline, and to limit August crude oil refining runs only to the extent of capacity of facilities.

"Now that more and more crude oil is being made available to East Coast refineries," said Petroleum Administrator Ickes, "it is desirable that increased quantities of home-heating oil be produced to provide a cushion for the winter months. That is why refiners have been asked to make more fuel oil of this type, even if in so doing, they must reduce the quantity of residual (industrial) fuel oil that is made."

Deputy Petroleum Administrator Ralph K. Davies said that lifting of quotas on crude oil runs in Eastern refineries is possible because of increased transportation facilities now available on the East Coast. He said:

"The overall transportation situation, so far as petroleum is concerned, is better than it has been since the war began, and it is still improving. As a result it is now possible to bring in more crude oil, and we can now authorize East Coast refineries to operate without quotas on crude oil runs.

"It is with considerable satisfaction that we make this announcement, for this is the culmination of a long-range planning program that was initiated many months ago by the Petroleum Administrator for war, in cooperation with the petroleum industry, the railroads, the pipeline companies, and waterway transportation operators."

How much additional home-heating oil will be made as a result of the lifting of quotas and the request to increase the yield of this type of oil cannot be determined at this time, but Mr. Davies expressed confidence that the East could be assured of as much fuel oil as it received last year —perhaps more.

Industrial Users Aided

The second development stemming from improved transportation was announced on August 21, when plans developed to permit certain users of fuel oil for commercial, industrial or governmental purposes to obtain emergency reserves of oil.

Under the fuel rationing procedure announced by the Office of Price Administration, users of fuel oil for industrial commercial and similar non-heating purposes, are issued allotments on a three-month basis, these rations representing minimum requirements. The emergency reserve, or working inventory arrangement, is intended to guard against enforced shutdowns of those companies whose reserves are depleted and who might not be able to obtain their fuel oil in midwinter because of transportation difficulties or other temporary delays.

Army Looks to Future

With an eye on the eventuality of victory, although no prediction is made as to time, uniform policies and procedures to be followed in terminating war contracts are set forth in Procurement Regulation No. 15, issued by the War Department, effective September 1. The instructions detail the responsibilities and obligations of contracting officers and contractors in connection with the termination of lump sum supply contracts, lump sum construction contracts, cost plus a fixed fee contracts, and preliminary contractual instruments such as letters of intent and letter orders.

Following are the nine major principles the Army proposes to apply on termination:

1. Cessation of work on the contract, both by prime and subcontractor, is to stop promptly unless the contracting officer determines continuance to be in the best interest of the government. Purpose of such cessation is to avoid further expense to the government and to save labor and material;

2. Disposal of materials required in the contract is to be made with "reasonable-dispatch" so as to make the material available for other productive use promptly. Materials not disposed of are to be transferred to the government;

3. Payments to contractors are to be "fair and reasonable" compensation for the work performed and for the supplies and articles furnished under the terminated contracts, consistent with the provisions of the applicable contract article relating to the termination;

4. Payments are to be prompt and without administrative delay;

5. Intelligent reviews are to be made of contractors' requests for payments but to avoid delays, detailed auditing will be reduced to a minimum consistent with the protection of the government's interest;

6. Full use must be made of provisions on partial payments so that all amounts clearly due contractors will be paid at the earliest possible moment;

7. Advance payments and guaranteed loans will be liquidated in an orderly manner with regard to protecting the contractor's financial structure;

8. Prime contractors must be pressed to effect "fair, prompt and reasonable" settlements to subcontractors and suppliers and pass on to them a reasonable share of partial payments; and

9. Where contractors are directed to reduce production by partial termination, equitable adjustments of costs will be made consistent with the applicable contract articles or with appropriate and equitable supplemental agreement in the event that the change causes an increase in the contractor's cost.

Firms employing 100 workers or less are to be given preferred consideration if they are reasonably efficient.

AUGUST WASHINGTON NEWS HIGHLIGHTS

Editor's Note: In addition to its summary of Washington activities, HEATING AND VENTILATING publishes a monthly index to news releases and other publications of interest to the industry. The figure at the left of the column below is the release date; the figure at the end of the listing is the release number. Copies of releases may be secured by writing Office of War Information, Room 1501 Social Security Building, Fourth and Independence Avenue, Washington, D. C.

21st—LAKES COAL SHIPMENTS RESTRICTED. Solid Fuels Administrator Ickes announced today that shipments of coal from upper Great Lakes docks to areas beyond those normally served from docks will be halted, effective August 24. OWI-2365.

21st—CONSTRUCTION DROPS 1 PER CENT. Volume of construction activity in United States declined virtually as scheduled during month of June to $710,260,000, WPB announced today. This was 1 per cent below May volume and 43 per cent drop from $1,244,047,000 total in corresponding month of last year. WPB-4090.

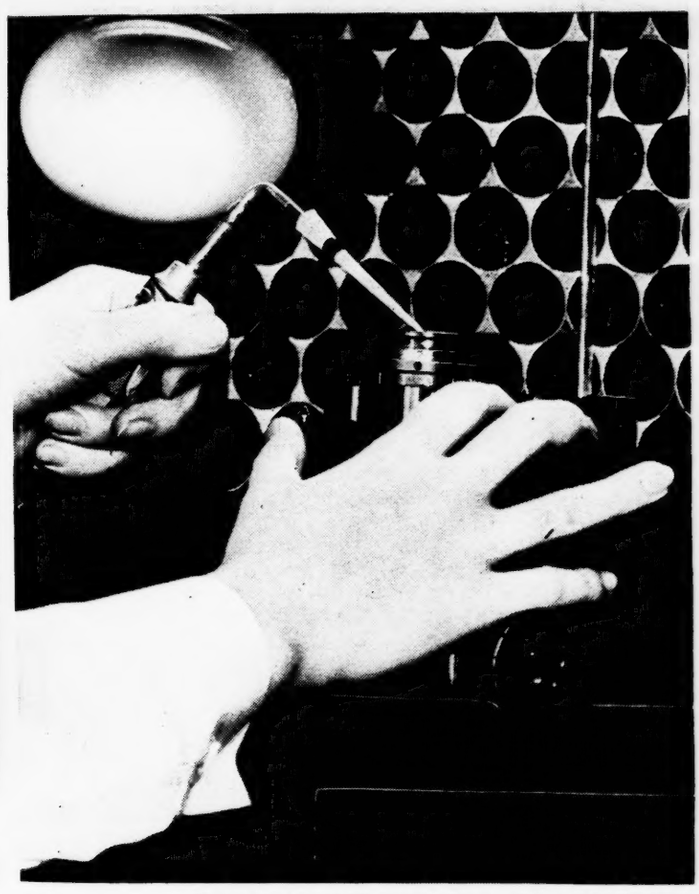
18th—EAST COAST PETROLEUM SUPPLY. Decline in index of principal petroleum stocks available to civilian consumers on East Coast to 34.5% of normal and draft on gasoline stocks of 22,700 barrels per day during week ended August 14 were announced today. OWI-2354.

17th—100-OCTANE GAS PROGRAM. Organization of expanded Construction Division whose principal function will be to expedite construction of 100-octane aviation gasoline plants was announced today. OWI-2344.

16th—COAL SHIPMENTS EAST DECLINE. Coal shipments to New England direct from mines by all-rail routes declined slightly in week ending August 7. OWI-2327.

10th—REFRIGERANT-CONTROL TIGHTENED. Chlorinated hydrocarbon refrigerant will be more tightly controlled under terms of an amendment to Order M-28, issued August 7 by WPB. WPB-4019.

9th—METAL DEMANDS EXCEED SUPPLY. That military and essential civilian demand for critical metals will outrun available supplies is made clear in fourth quarter allotments of controlled materials completed by the WPB Requirements Com. WPB-4016.



Photos Courtesy of Minneapolis-Honeywell Regulator Company

No "bombers" in our gun sights

THIS GIRL is assembling the lenses of an anti-aircraft fire-control device.

The second picture is a close-up of the work. At the back of her work bench, is a Dust-Stop* Air Filter.

Out of this filter a stream of clean moving air blows away any dust that may be floating around above the work bench and prevents it from settling on the lenses she is assembling.

If a speck of dust, even 1/10,000th of an inch in diameter, were to get on one of these powerful lenses, magnification would make it look like an enemy "bomber" to the gun sighter.

More examples . . .

This is only one example of scores of Dust-Stop applications that are helping in the accuracy of manufacture and assembly of delicate instruments and parts.

In scores of war plants, Dust-Stops are today removing grit, grime, and manufactured dusts from the air. They are helping guard the accuracy of bomb sights, tank parts, and numerous other precision instruments and assemblies. The result is fewer rejects.

Surprisingly low in cost

As original equipment for commercial and industrial installations, Dust-Stops cost only about 1¢ per CFM to install. Their replacement cost is less than 1/10th of 1¢ per CFM.

Dust-Stops may also be vacuumed cleaned or gently rapped out to remove excessive surface dust accumulations. This process may be repeated once or twice to reduce maintenance costs further.

Yes, Dust-Stops are available. They are made from all-American materials which are not now listed as critical.

Ask your regular supplier about Dust-Stops. If he cannot give you complete technical data, write today to *Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

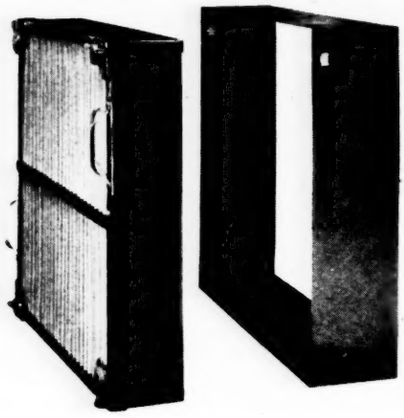
FIBERGLAS*

DUSTOP*

*T. M. Reg. U. S. Pat. Off.

AIR FILTERS

NEWS OF EQUIPMENT AND MATERIALS

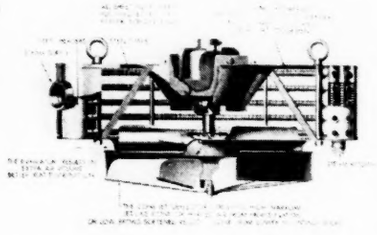


Panel Filter

NAME—Wire-Klad panel unit filters.
PURPOSE—Air filters for use where flame resistant unit is desired, as in schools, churches, auditoriums, public buildings, and department stores.
FEATURES—Retains Protectomotor fin construction principle but has additional safety feature of a medium protected on both sides with a rust-resisting wire screen cloth which reinforces medium and minimizes danger of combustion when exposed to flame. Can be quickly cleaned by vacuum cleaner, compressed air, or by flushing. Element is locked into protecting steel panel box or frame with spacing bars keeping fins even for uniform air flow. Unit has low pressure drop. The low cost feature is due to light weight construction, elimination of supporting bridges, and elimination of expensive materials. Available in 2 and 4 in. deep units in five frame sizes.
MADE BY—*Staynew Filter Corp., Rochester, N. Y.*

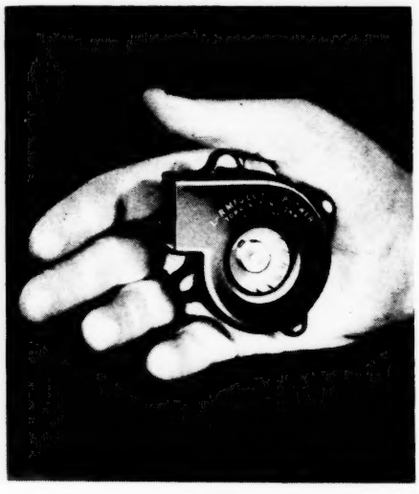
Modine Unit Heaters

NAME—Modine vertical delivery unit heaters.
PURPOSE—For wartime application; heater has steel condensers.
FEATURES—Steel condensers protected by lead alloy coating from corrosive elements present in the average industrial atmosphere. Fins bonded to tubes with metal. Tubes and headers are brazed with silver solders to form an integral unit of steam carrying passages guaranteed for steel pressure up to 150 lb per sq in. Available with standard cone-jet deflectors or anemostats to meet practically any air diffusion requirements. Larger models may be mounted as high as 50 to 60 ft above floor.
SIZES AND CAPACITIES—From 149,000 Btu per hr to 600,000 Btu per hr.
LITERATURE AVAILABLE — Bulletin 143-B.
MADE BY—*Modine Manufacturing Co., Racine, Wisc.*



Plastic Blower

NAME—L-R plastic blower No. 1½.
PURPOSE—Miscellaneous blower applications requiring exceedingly low air quantities.
FEATURES—Unit has an output of 15 cfm at 3000 rpm. The housing is of one piece molded high impact plastic while the wheel is of turbo type cadmium plated steel 1½ in. in diameter. The wheel and housing together weigh only 2 ounces. A backplate facilitates mounting on any type motor.
MADE BY—*L-R Manufacturing Company, Torrington, Conn.*



Plastic Reducer

NAME—Saran plastic reducing coupling.
PURPOSE—For joining different sizes of Saran tubing.
FEATURES—This new coupling is an adaptation of the Saran union coupling with the same flexibility, toughness, resistance to chemical action, long life and ability to perform under unusual conditions.
SIZES—For Saran tubing sizes of ¾ in. to ⅛ in., with ⅛ in. reduction.
MADE BY—*Commercial Plastics Co., 201 North Wells St., Chicago, Ill*

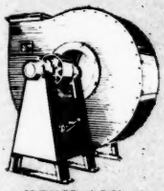
Micro Pressure Switch

NAME—Micro pressure-switch.
PURPOSE—For proportioning control of motor-operated valves, power units, program switches, etc., for the regulation of steam, air and gas pressures. Among the applications are control of steam boilers, automatically fired by proportioning type oil burners, gas burners, and stokers, suction pressure of multiple Freon compressors and regulation of head pressures in liquid level control.

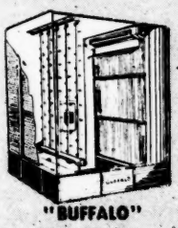
FEATURES—A single-pole double-throw 3-wire instrument with positioning solenoid. Pressure sensitive bellows mechanism, mounted on bakelite sub-base and enclosed in a metal case for surface mounting. Built-in condenser protects contacts. Convenient external adjustment, but setting may be locked in place by means of internal locking screws. Control circuit is simple 4-wire—single-pole double-throw for 3-wire operating circuit plus additional wire for positioning solenoid.
LITERATURE AVAILABLE—Bulletin F-1917.
MANUFACTURER — *Barber-Colman Co., Rockford, Ill.*

"BUFFALO"
Limit-Load Ventilating Fan

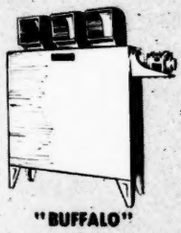
"BUF-FLOW"
Axial Flow Fan



"BUFFALO"
MX Mill Exhauster



"BUFFALO"
Air Washer



"BUFFALO"
Highboy Unit Heater

"BUFFALO"
Breezo Ventilating Fan

"BUFFALO"
Type E Blower

"BUFFALO"
Volume Fan

SHORTCUTS TO ...EFFECTIVE Ventilation

✓ READILY INSTALLED

✓ LOW INITIAL COST

✓ ECONOMICAL TO OPERATE

If the need for improved ventilation is urgent—and the installation of large scale systems is not practical—these three husky Buffalo Fans can solve many a problem. Spot them anywhere about the plant. Installation is easy and inexpensive. Modern design assures exceptional efficient air handling for nearly all industrial applications. For complete engineering data, write for Bulletin 3222B.

ARMY E NAVY

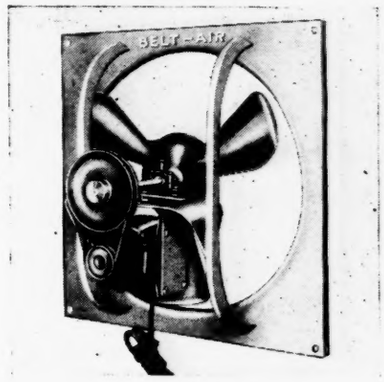
BUFFALO FORGE CO.

480 Broadway **Buffalo, N. Y.**

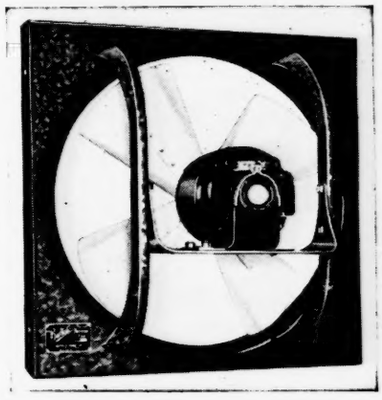
Branch Engineering Offices in Principal Cities
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

★

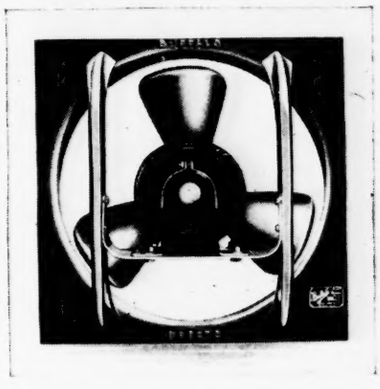
IT'S "Buffalo" FOR VENTILATION



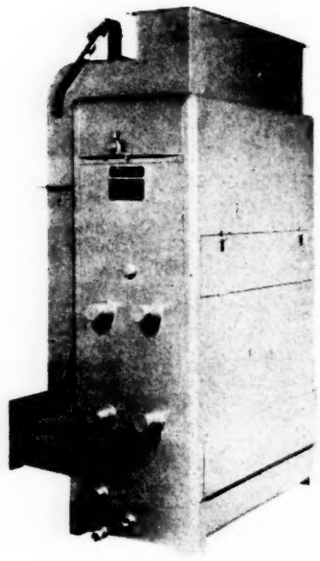
Buffalo "BELT-AIR" FANS. Large capacity, low in cost, extremely quiet. Simple, sturdy construction, powered by motors of standard manufacture. Available in 5 sizes.



Buffalo "NV" FANS. Heavy-duty, propeller type fans for use against moderate pressures. Available in 7 sizes. Suitable for the more strenuous industrial applications.



Buffalo "BREEZO" FANS. Sturdily constructed light-weight fans of the panel type of general ventilation. Quiet and dependable. Available in 6 sizes.

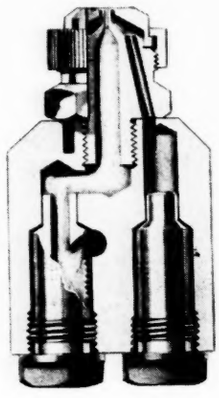


Niagara Heat Exchanger

NAME—Niagara Aero heat exchanger.
PURPOSE—For adding heat to industrial liquids to maintain constant temperatures with automatic control.
FEATURES—Unit is of evaporative type using a water spray and fan to draw air over coils containing liquid whose temperature is to be controlled. Spray water is heated by steel coil, injector, or electric heating unit. Heating device is put into operation by thermostatic control at desired point, preventing liquid from becoming too cold for the process or from becoming viscous with retarded flow and loss of capacity, or from congealing or freezing. This also makes it possible for the heat exchanger to be installed successfully out of doors, or to use out-of-door air to increase its evaporative cooling capacity and avoid damage from handling air containing corrosive substances.
MADE BY—*Niagara Blower Company, 6 E. 45th St., New York 17, N. Y.*

Pneumatic Atomizing Nozzle

NAME—Type JHS pneumatic atomizing nozzle.
PURPOSE—A spray nozzle for use in processes requiring close control of atmospheric conditions.
FEATURES—Water and compressed air are mixed externally to produce round spray which is projected from 10 to 20 ft depending on air pressure used in humidifying system. Can be quickly adapted to most types of installation. Two monel metal strainers—one for air and one for water—are included in body of nozzle permitting easy removal of strainers for cleaning or replacement without disturbing nozzle or lines. Parts machined of brass and white coated. Long useful life of nozzle claimed.
MADE BY—*Spraying Systems Company, Chicago, Ill.*

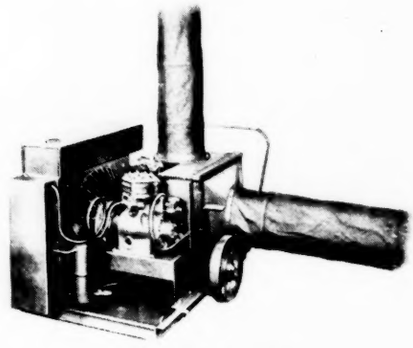


Pressure Switch

NAME—Pressure switch.
PURPOSE—Controlling pressures in liquids, air or gases.
FEATURES—Suitable for operation at pressures up to approximately 100 lb and has a very high degree of accuracy. Switch operation depends upon the effect of pressure on a specially designed spring compensated bellows that operate a unique snap-action beryllium copper switch. For control of pressures within its range, the switch is designed for reliability and ruggedness with its main emphasis on accuracy. It can be used for either direct current or alternating current.
MADE BY—*The Vapor Car Heating Company, 80 E. Jackson Blvd., Chicago, Ill.*

Weld Symbol Hammer

NAME—Atlas weld symbol hammer.
PURPOSE—For making permanent markings on welds to reveal identity of welder and welding inspectors.
FEATURES—Device is a combination weld marking tool and chipping hammer. Tool features keyed symbol in form of alphabetical and numerical combinations or distinctive outline symbols available in combinations to place permanent and definite responsibility for every weld. Tips and bits are interchangeable and replaceable.
MADE BY—*Atlas Welding Accessories Company, 307 Boulevard Bldg., Detroit 2, Mich.*



Mobile Cooler

NAME—Mobile cooler and dehumidifier.
PURPOSE—For use by armed forces and for essential war tasks.
FEATURES—For such applications, for example, as cooling workers repairing the interior of an airplane standing in the sun and where air temperatures of 150 to 160F might make it impossible for a mechanic to stand the heat. Unit is completely self-contained, weighs about 600 lb. Can be wheeled on retractable wheels and has a sled-like bottom with rings for towing through sand. Condenser and evaporator both use steel tubes, and fins and refrigerant piping are also made of steel to conserve critical materials.
MADE BY—*Carrier Corporation, Syracuse, N. Y.*

Illinois CONTROL SYSTEMS

for Maximum Fuel Savings

To reduce fuel consumption and insure satisfactory steam circulation, look to the control of your heating system.

ILLINOIS Control Systems insure complete and accurate regulation of steam flow. There is a type to meet every heating condition in any installation, large or small.

Combustion Control . . . Flow Control — either Continuous Flow or "on and off" types . . . Modulation . . . and each system admits of special variations. Operation may be electrical or pneumatic, automatic or manual, or a combination of both.

Why not check up on your heating system now to have it at top efficiency for the winter months ahead?

Just drop us a line for bulletins and further details

ILLINOIS ENGINEERING COMPANY
INCORPORATED 1900
RACINE AVENUE AT 21ST STREET • CHICAGO

NEWS OF THE MONTH

Servel Announces Post-War Plans

NEW YORK—Postwar plans providing for the manufacture and distribution of the Servel all-year gas air conditioning unit for homes and small commercial establishments were announced August 25 at a preview for the press here.

Although public introduction of the new air conditioning unit cannot be made until after the war, as the company is now entirely converted to war production, Servel officials stated their distribution, advertising and sales promotion plans are now being discussed with utility outlets so that adequate personnel can be trained to sell, install and promote the product.

George S. Jones, Jr., vice president in charge of sales for the company, presided as chairman at the meeting. He is in charge of Servel's postwar program to enlist the cooperation of gas companies in formulating marketing plans for the distribution of gas air conditioning and other gas appliances soon after peace comes. Meetings for this purpose, Mr. Jones said, have already been held in key cities throughout the country.

Mr. Jones revealed that 27 large gas utility companies already have more than 300 test installations in the territories they serve—all of which are giving evidence of superior consumer acceptance. He said that Servel has been developing the all-year air conditioner for nine years and that during the war period, research men of the company have been busy checking and field-testing the 300 installations made prior to Pearl Harbor so as to profit from this experience in all sorts of climatic conditions.

Mr. Ruthenburg who is also Indiana State Chairman for the C.E.D. and president of the Indiana State Chamber of Commerce said that his company was particularly interested in maintaining a high level of employment for returning soldiers and sailors as well as civilians after the war.

Mr. Ruthenburg said that the manufacture of the air conditioning unit will give postwar employment to men and women in his company who are now engaged in producing war materials as well as jobs for former company employees now in the armed services. Mr. Ruthenburg added that the new unit should also aid in reemployment of workers and returning soldiers and sailors in those parts of the country where the gas companies are preparing to begin distribution after peace arrives.

John K. Knighton, sales manager of the gas air conditioning division of Servel, after describing the new product, explained that the test units were installed in various sections of the country, where careful studies were made on climatic conditions, living habits of people, building regulations and other important information relating to engineering and service.

Mr. Knighton said that field reports indicate quiet and economical operation of all test units. He said that the new air conditioner has enjoyed considerable success throughout the United States and that wide development of the postwar market is anticipated.

Robert J. Canniff, advertising and sales promotion manager of Servel, in reviewing the proposed postwar advertising campaign for all-year gas air conditioning said a coordinated program of advertising would be employed utilizing key city newspapers and magazines, trade papers, radio and other channels of information.

Courses in Marine Ventilation

LONG BEACH, CALIF.—Supervised by the engineering, science and management war training program of the University of California, tuition-free courses in marine ventilation and marine piping have been inaugurated here for workers in Long Beach and Los Angeles harbor district shipbuilding and allied industry plants.

The night courses in marine ventilation deals with air distribution and exhausting systems of ventilation equipment. The courses in marine piping offer technical training to persons already engaged in installation, design and application of piping as specifically applied in marine practice.

QMC Develops Tent Oil Burner

WASHINGTON—A simple oil-burning fire unit, designed for operation on liquid fuels ranging from gasoline to diesel oil, has been developed by the Quartermaster Corps to convert the standard coal-burning Army tent heating stove into a smokeless oil-burner.

Along with the unit, the Quartermaster Corps has designed an "adapter," or coupling device, attached to a long tube which permits the standard five-gallon field gasoline container to be used as a fuel tank for the stove.

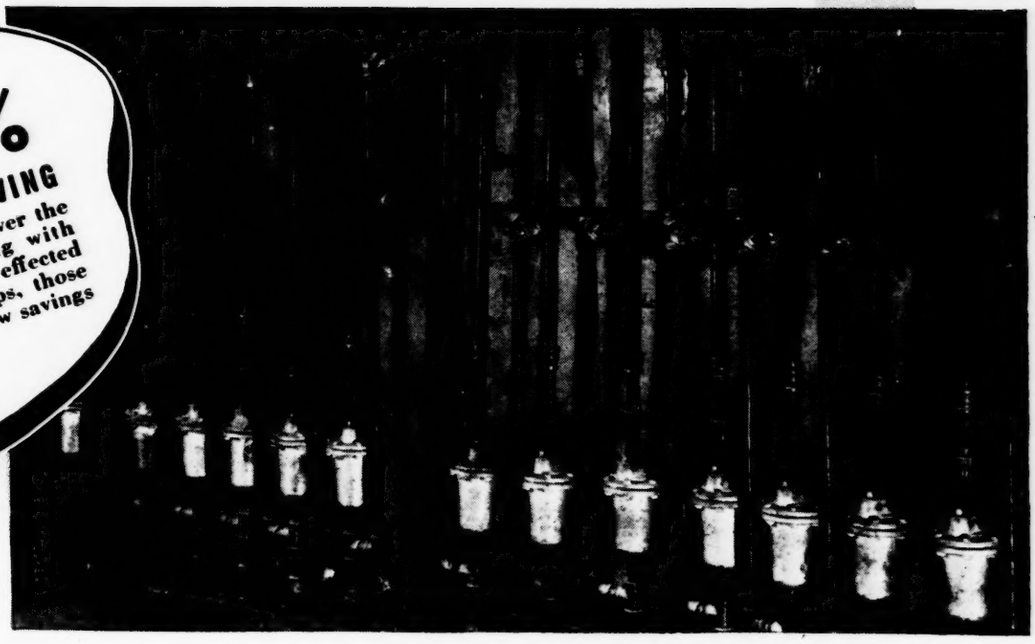
The fire unit is designed to fit into the base of the stove when the coal grates are removed, and is equipped with three air intake vents to obtain better combustion and consequently less unconsumed oil with its resulting smoke. The fuel is fed into the fire unit by gravity through a safety float valve which regulates and controls the amount of fuel reaching the burner.

The coupling device which adapts the gasoline container for use as a fuel tank is fitted with a vent pipe to allow air to flow into the container as the fuel flows out.

Tests have shown that the new burner will provide heat comparable with that from the maximum amount of coal the stove will hold. But unlike the coal, it will burn without smoking, which makes it suitable for use in any theater of operations from deserts to snow-covered mountains, without danger of smoke disclosing the location of troops.

Maintenance Saving

72.5%
MAINTENANCE SAVING
Of reports turned in over the past 13 years dealing with maintenance savings effected with Armstrong Traps, those that give figures show savings averaging 72.5%.



Ask for the Armstrong Trap Book, giving facts and figures on all trapping problems.

. . . a BIG HELP in the manpower emergency

SINCE most trap installations are made chiefly to secure maximum heating efficiency and minimum fuel consumption, the manpower necessary to maintain the system in top condition is not often considered. But in the present manpower emergency, this factor assumes important proportions.

Simple, positive operating Armstrong Traps, with corrosion proof mechanism and self-scrubbing action, minimize trap and steam line maintenance—eliminating an irritating nuisance and freeing busy engineers for more productive work.

Two examples:

. . . 50 Armstrong traps, including 32 on a Proctor & Schwartz dryer, reduced maintenance on steam lines from 20 man days per month to only one day per month!

. . . On an installation of 300 Armstrong Traps in a photo supply plant, trap maintenance was reduced as much as 50% over that required for previous equipment.

Armstrong Traps repay their cost in other ways too; in fuel saving, heating time saving, and savings in steam generating requirements. An Armstrong Trap representative will be glad to give you details, and help you on trapping problems.

ARMSTRONG MACHINE WORKS
846 Maple Street • Three Rivers, Michigan

ARMSTRONG — INVERTED BUCKET STEAM TRAP

Armstrong STEAM TRAPS
HUMIDIFIERS • PURGERS

ASHVE to Hold 50th Annual Meeting

NEW YORK — "The Past", "The Present", and "The Future" will be effectively portrayed at the 50th Annual Meeting of the American Society of Heating and Ventilating Engineers to be held at the Hotel Pennsylvania here, Jan. 31, Feb. 1 and 2, 1944.

It was in the summer of 1894 that a small group met to organize the ASHVE and in the report of the deliberations on September 10, it was significant that "temperature conditions were decidedly uncomfortable, but the meeting was very well attended." At this meeting the objects of the Society were outlined and a Constitution and By-Laws were adopted.

To properly commemorate the 50th Anniversary of the organization of the Society the Committee on Arrangements of the New York Chapter is developing a special program which will be appropriate for the occasion.

A three-day session will be held and technical papers of basic importance will be presented. The organization of the Committee on Arrangements has been announced by Alfred J. Offner, General Chairman, as follows:

Honarary Chairmen: Homer Addams, W. H. Carrier, W. H. Driscoll, W. L. Fleisher, and D. D. Kimball; *Vice-Chairmen:* R. H. Carpenter, J. C. Fitts, W. E. Heibel, C. S. Koehler, Capt. A. E. Stacey, Jr., U. S. N. R., and R. A. Wasson, President of the New York Chapter, ex-officio; and *Chairmen of Special Committees:* H. S. Wheeler, Hospitality; Alfred Engle, Banquet; W. M. Heebner, Finance; Mr. and Mrs. H. J. Ryan, Ladies; C. S. Pabst, Inspections; R. V. Sawhill, Publicity; E. J. Ritchie, Sessions; A. C. Buensod, Special Events.

Soft Coal Research Appoints Tobey

WASHINGTON — Julian E. Tobey has been reappointed chairman of the technical advisory board of Bituminous Coal Research, Inc., according to Howard N. Eavenson BCR president, who made the appointment following the board's nomination of Mr. Tobey at its meeting at Battelle Memorial Institute, Columbus, Ohio, July 21.

As chairman of the technical advisory board of the bituminous coal industry's research agency, Mr. Tobey will continue his leadership of this body, which has active direction of the industry's research program aimed at the improved and increased use of coal in residential and industrial applications. He also continues as chairman of the technical executive committee; he has held both positions since the board was organized in March, 1941.

Mr. Tobey is managing director of the Coal Bureau of the Upper Monongahela Valley Association, Chanin Building, New York City, and is one of the country's outstanding fuel engineers, specializing in coal utilization.

To facilitate the handling of an increasing number of BCR research projects, each requiring careful consideration and discussion with the Battelle engineers who conduct the research, sub-committees were appointed by Mr. Eavenson on hand-fired heating equipment, residential stokers, dustless treatment, railroad locomotives, gasification and carbonization, and industrial utilization.

C. F. Hardy, manager of the Fuel Engineering Division of Appalachian Coals, Inc., Cincinnati, was appointed chairman of the newly formed sub-committee on hand-fired heating equipment, which will report on projects concerned with developments on smokeless stoves and water-heaters, and household furnaces.

The residential stoker sub-committee will be directed by Fred K. Prosser, coal traffic manager of the Norfolk and Western Railway Company, of Roanoke, Va. A household stoker is under development at Battelle for BCR, designed to accomplish both bin-feeding of coal and automatic removal of ash, with ability to burn a wide range of coal types.

Flexible Pipe Lines for Army

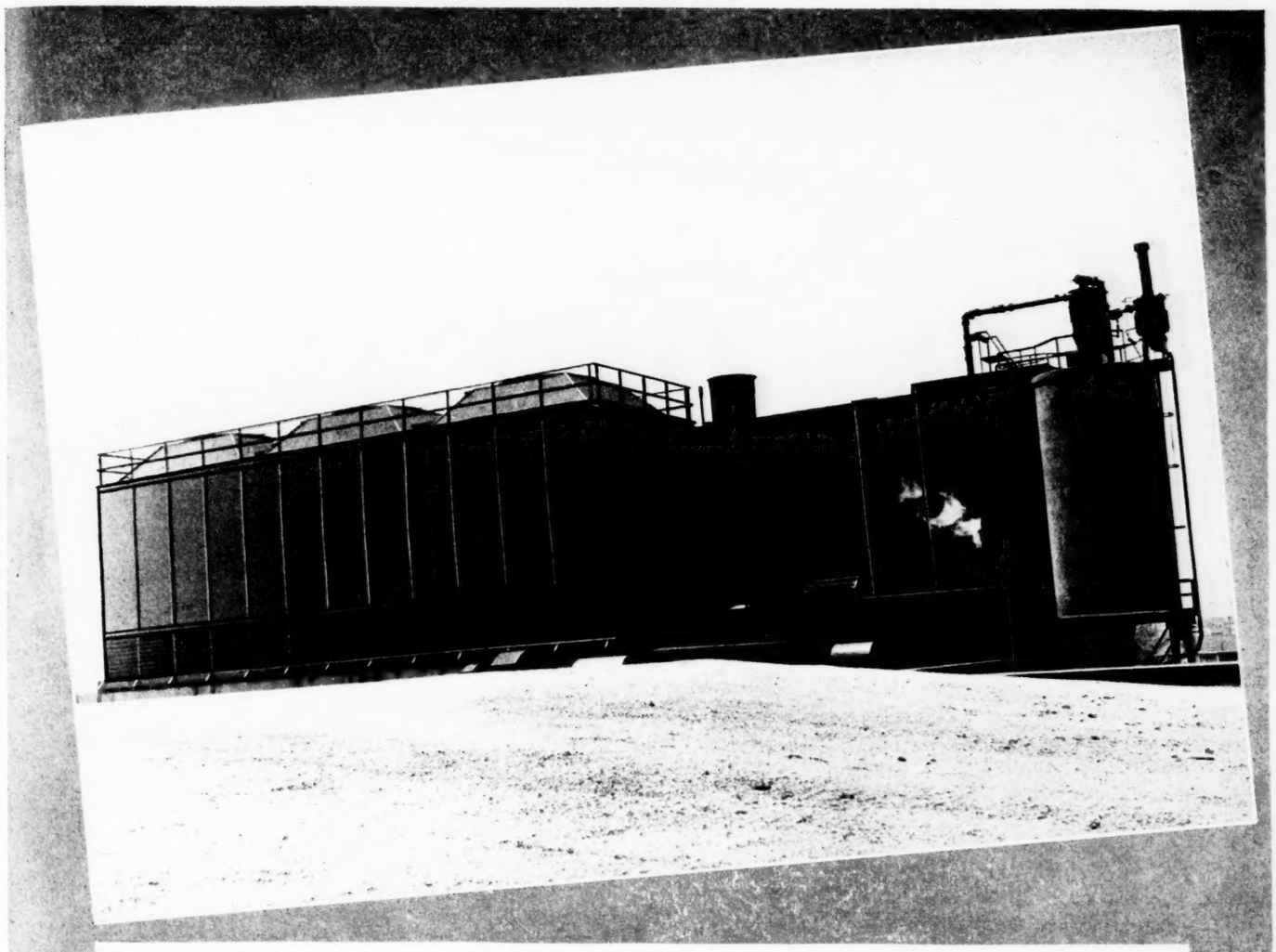
NEW YORK—Shell Oil Company, Inc., has revealed that gasoline and water is being transported in Sicily by flexible pipe lines which can be laid at the rate of twenty to thirty miles a day by Army personnel. It was reported that one of the reasons for the rapid advance for the United Nations in Sicily and Africa was because petroleum could so quickly be brought to the front.

The lightweight flexible pipe is made in twenty-foot sections, each section weighing only ninety pounds. It can be lifted and carried by one man. The total weight per mile, including the pumping stations, which are located ten miles apart, is about thirteen tons. The cost of the material, excluding transportation and labor, is about $3,000 a mile. The pumps are operated by gasoline-fueled engines.

So far as is known the first portable pipe line for transporting gasoline in war was put in operation by the Germans in the advance through the Low Countries and France in May and June, 1940. However, the portable lines used by the Germans were for much shorter distances and the pipe was only two and one-half inches in diameter and was made partly of aluminum. The pipe used by the United States is made of steel with a spiral construction in order to give it strength and reduce the weight.

Early in 1941 the Shell Oil Company authorized an expenditure of $10,000 for portable pipe line experimentation in the Middle West and a short line was constructed. The experience gained then was made available to the War Department and a thirty-mile line with four pump stations was laid along the Skyline Drive in the Blue Ridge Mountains in Virginia.

The portable pipe line is of both four-inch and six-inch construction. The four-inch line has a capacity of 6,000 barrels daily, or 25,000 gallons, while the six-inch line has a capacity of 10,000 barrels daily. The larger size is used mainly for short distances, such as from a tanker to terminal installations on shore.



☆ **COOLING TOWERS** are an important part of the silent service operating behind the lines. The operation of the most perfect mechanical equipment in the world *can only be as good as the auxiliary equipment which serves it.*

The fact that Water Cooling Equipment Corporation Cooling Towers are serving the Air Corps, The Army, The Navy and the great production plants of the country, is ample evidence of their absolute dependability under the most exacting conditions.

WATER COOLING EQUIPMENT CORPORATION

8601 New Hampshire Road — *Affton Station, St. Louis, Mo.*

Oil Heat Institute Reports on Objectives

NEW YORK—The directors of Oil-Heat Institute of America met in New York recently and heard C. E. Lewis, president, report on the status of the various objectives of the Institute: (1) liquidation of frozen inventories; (2) gaining of a simplified fuel oil rationing program for the 1943-44 year; (3) meeting of the forced domestic conversion program; (4) unification of the industry, and the formation of a distribution division whereby various distributor groups would be organized in the various trading centers and would tie in equipment and fuel oil distributors with equipment and accessory manufacturers; (5) to get the complete story on the postwar oil supply and to get the favorable aspects of the situation to the public and to users of oil heating equipment; (6) to develop postwar planning for the industry; (7) to organize an over-all advertising and promotional program to further the interests of oil heating and to overcome the adverse publicity which has been directed against oil heating due to the war situation and the high demand for petroleum products for war use.

Mr. Lewis also reported on the success attending the organization meeting of the distribution division at Chicago and noted that oil heat marketing executives attending represented all sections of the country and 85% of the equipment moving through distributor channels. Introduced at the Board Meeting were Frank E. Spencer of Chicago, E. E. Hadlick of Minneapolis and F. N. Beckwith of Boston, who had been nominated for places on the board of directors of O.H.I. by the distribution division. Mr. Spencer is national chairman of the distribution division, and Ray F. Horan is secretary.

Proper Heating Determines Plane Effectiveness

LOS ANGELES—Heating airplanes has lagged behind other improvements, Wilbur W. Reaser, engineer in charge of air conditioning, Douglas Aircraft Company, Inc., Santa Monica, Calif., said in an address to the American Society of Mechanical Engineers at its semi-annual meeting here recently. But since war has shown that heating systems are essential equipment, he predicted that in the future they will be more efficient, lighter, last longer, and be simpler to operate. They will have to be, he said, because war has proved airship effectiveness depends on proper heating.

According to Mr. Reaser, prior to the war, an airplane cabin heating system, although required to conform to certain specifications, was more likely to be relegated to any space remaining after other equipment was designed. Wartime flying in the Far North and the troposphere has proved that airplanes are not effective unless they have adequate heating systems, he said.

The speaker listed six properties to be determined before the heating system can be designed. He discussed the advantages gained by supplying the heating distribution system with temperatures as high as possible, and gave computations showing why a ceiling air distribution system is preferable to a floor distribution system. He showed diagrams comparing thermal circuits for the wall of an airplane cabin and for a man's body, and compared advantages and disadvantages of three heating systems used by the Douglas Company—steam, exhaust hot air, and internal combustion. Critical comparison of these types, he said, shows that the steam system is heavy, unreliable in freezing temperatures, and requires frequent replacement of the boiler, but is safe and, with improvements in design, may be of use in the future airliner for humidifying the cabin air. The chief objection to the exhaust hot air heating system, the speaker explained, is the possibility of carbon monoxide gas entering the cabin. Still, he believes, the system is the simplest and most reliable in cold weather. The first type of combustion heater fails to start in cold weather and is short lived. A newer type employs a different combustion principle which makes it start readily at low temperatures. This heater is light in weight, has shown long life in ground endurance tests, and, with the addition of a light weight electric motor driven fan, will supply heat independently of the engines while the airplane is on the ground.

Foresees Refrigerated Cargo Planes

NEW YORK — Fleets of giant refrigerated cargo planes which will bring the world's produce to the American dinner table hours instead of days after it has been gathered may be one of the early results of wartime advances in refrigeration and air conditioning, according to S. E. Lauer, president of the York Corporation.

Super-refrigerated air freighters are possible even now because of the higher efficiency of refrigerants and decrease in size of the equipment, a development brought on by military needs, Mr. Lauer said. Such new equipment, he added, will play a major role in solving the nation's food problem through greater production of quick frozen and dehydrated foods and storage facilities for preserving produce for indefinite periods.

Virginia May Adopt Boiler Code

RICHMOND, VA.—Governor Darden said recently he would recommend the passage of a boiler code to the next session of the General Assembly. To this end he has conferred with a committee of the local chapter of the ASHVE of Engineers and the Central Virginia Engineering Club.

The engineers said they have set up the committee to advise anyone on the technical details of the code, but not to sponsor the measure.

A boiler code of one kind or another has been before the General Assembly for the past 20 years, but always has failed—the last time in 1942 when various individuals and associations came late in the

(Continued on page 98)

Miles Up . . . On The Ground

IN ORDER that high-flying bomber pilots, gunners and navigators may become accustomed to the rarefied atmosphere encountered at high altitudes, and that student pilots may be graded with regard to their resistance to lack of oxygen and susceptibility to "bends", a long and rigorous series of tests is undergone by all fliers in decompression test chambers, where conditions found at any given altitude may be duplicated.

Great care is taken during these tests to make certain that no condition, other than reduced pressure and lack of oxygen, is allowed to affect the occupants and cause inaccuracies in the grading of the fliers. It is of utmost importance that the temperature in the chamber be held at or near a normal point. Refrigeration, through air conditioning of these decompression chambers is, therefore, an important part of this vital step in the selection and training of our superb fliers for combat duty.

All over the world, in the air, on land and sea, wherever refrigeration is playing its important role, will be found "Detroit" refrigeration products—helping in many ways to win the war today—and contributing to the world's health and well being tomorrow.

•

"Detroit" Expansion Valves and Controls are doing their bit for Victory all over the world. Wherever there is need for refrigeration or air conditioning, there you will find Detroit products.

DETROIT LUBRICATOR COMPANY *General Offices:* **DETROIT 8, MICHIGAN**

Division of American Radiator and "Standard" Sanitary Corporation

Canadian Representatives—RAILWAY AND ENGINEERING SPECIALTIES LIMITED, MONTREAL, TORONTO, WINNIPEG

"DL" Heating and Refrigeration Controls • Engine Safety Controls • Safety Float Valves and Oil Burner Accessories • Radiator Valves and Balancing Fittings • Arco-Detroit Air and Vent Valves • "Detroit" Expansion Valves and Refrigeration Accessories • Air Filters • Stationary and Locomotive Lubricators

Virginia Boiler Code

(Continued from page 96)

session to say they had not had an opportunity to study the measure.

A recent explosion at a paper plant which was fatal to nine persons, lent new impetus to the move, and may be the means of bringing the matter more forcefully to the attention of legislators.

In the absence of a boiler code in Virginia, the State, it is said by John Hopkins Hall, Labor Commissioner, has become the dumping ground for boilers too unsafe to pass the inspections of neighboring States.

H. N. Booth

PHILADELPHIA—Harry N. Booth, for the past five years branch manager of the Philadelphia office of The National Radiator Company, died August 4, at the age of 56 years, as the result of a heart attack.

WHAT READERS SAY

Air Conditioning and Accidents

EDITOR, HEATING AND VENTILATING:

A recent item in the *Cleveland Plain Dealer* reads as follows: "An alarming increase in home front casualties—industrial workers killed in accidents and others succumbing to maladies brought on by the feverish pitch of war production work — has been noticeable in the Cleveland area, Coroner Samuel R. Gerber revealed today.

"Thus far in 1943, county morgue records show 51 fatal accidents in industrial plants and this accounts for but 60 per cent of the estimated total, he said. He contrasted these figures with 34 industrial fatalities during 1940; 93 in 1941 and 98 in 1942.

"But accidents are not the only lamentable factor, the coroner said. He cited 1,643 fatalities due to heart attacks, received at the morgue thus far this year, saying that many of these were caused by long hours and hard work of war industry workers."

This raises a question in my mind as to whether the war pitch caused these accidents or whether it was the heat.

Cleveland has had an unusually warm summer this year, particularly with high humidities. It has always been my opinion that workers in these hot industrial plants slow down in the summertime and cannot stand the pace and are not expected to. Under the pressure of war undoubtedly many of these men try to do work both under hotter weather conditions and for longer hours than has been the case in the past. Certainly we know that the summer brings more heart failures than the winter, due to the extra strain on the heart during the hot weather.

Comfort cooling may be actually the means of keeping a man on the job instead of having him sick in a hospital or dead on the morgue bench. Cooling will prove its own value and its worth in prosecuting the war, and we should not stand idly by when people say, "Oh, we can get along without comfort cooling for the duration." 1,643 fatalities in Cleveland alone due to heart attacks this summer is something you can't laugh off.

Very truly yours,

Lester T. Avery, President

The Avery Engineering Company
Cleveland, Ohio.

Cast Boilers for Higher Pressures

EDITOR, HEATING AND VENTILATING:

Many heating and power plant engineers have found during the past few months that it has been nearly impossible to secure steel boilers for operating pressures from 15 lb to 75 lb steam.

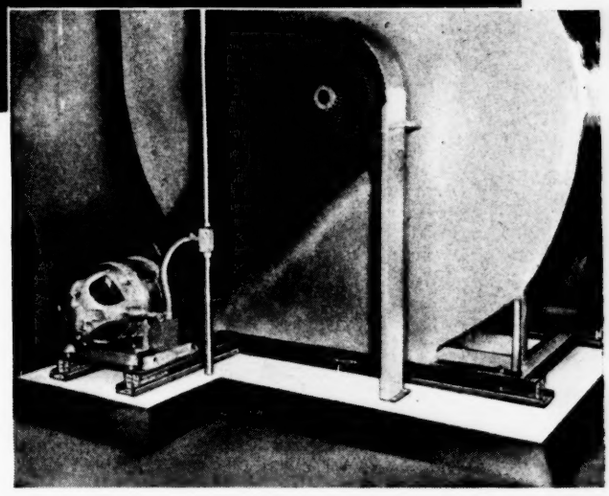
One answer to this problem is for the hitherto baffled engineer to consider the use of a cast iron boiler which has been designed to operate successfully at medium pressures. The Army and Navy as well as war goods producers have found this to be a very satisfactory solution.

The Navy has over fifty cast iron boilers in one project alone providing steam at 30 lb pressure for sterilization purposes in mess halls and hospitals. One industrial plant is using a cast iron boiler to supply 300F temperature water for process requirements (equivalent to steam at 78 lb at the boiler). These are but two examples of current installations.

Of course, it is essential that special cast iron boilers which are suited for operation at steam pressures above 15 lbs be used. The boiler sections should consist of many comparatively small tubes and surfaces should be rounded rather than flat to assure maximum strength . . .

The H. B. Smith Co., Inc. *J. E. Reed*
Westfield, Mass.

In leading Aircraft Plants...



KORFUND
VIBRATION CONTROL
helps speed production

ABOVE: Korfund Vibro-Bar Integral Base installed under a large fan and motor. Note how the welded steel construction provides an isolation base common to both the fan and its motor, thus maintaining constant alignment between them.

These Aircraft Producers use Korfund Vibration Control:

BELL AIRCRAFT
CESSNA AIRCRAFT
COLUMBIA AIRCRAFT
CONSOLIDATED AIRCRAFT
CURTISS WRIGHT CORP.
DOUGLAS AIRCRAFT
EASTERN AIRCRAFT
HUGHES AIRCRAFT
INTERCONTINENT AIRCRAFT
LOCKHEED AIRCRAFT
McDONNELL AIRCRAFT
NORTH AMERICAN AVIATION
NORTHROP AIRCRAFT
VEGA AIRCRAFT
WRIGHT AERONAUTICAL CORP.

Listed at the left are some of the nation's well known Aircraft Manufacturers who have installed Korfund Vibration Control Equipment in their plants. Realizing the danger of unchecked vibration as a drag on operating efficiency, they are using Korfund equipment to improve personnel efficiency, to increase machinery life, to achieve less spoilage and fewer rejections.

Korfund Vibration Control is applied to any type of reciprocal or rotary machine in such a way as to "isolate" it from the building structure and thus prevent the transmission of vibration. Steel springs, rubber, or cork may be utilized.

Over forty years' experience devoted exclusively to the design and manufacture of vibration-isolation products, plus 250,000 successful installations all over the nation and the world are your guarantee of satisfaction.

Whatever machinery vibration problem may be bothering you, you will find Korfund your anwer for economical and successful vibration control. Send for interesting literature or call our representative for consultation.

THE KORFUND COMPANY, INC.
48-33 THIRTY-SECOND PLACE LONG ISLAND CITY, NEW YORK

Fuel conservation and unit ventilators

COLD WEATHER will again find School Authorities struggling with the problem of fuel conservation.

Fortunate are those whose schools are equipped with Herman Nelson unit ventilators which operate in accordance with the Her-Nel-Co Method. These units when properly controlled introduce air from out of doors only when necessary for maintaining proper temperatures in the classrooms. They save all of the fuel formerly used to heat large quantities of cold air continuously introduced from out of doors even when not required.

Herman Nelson facilities are now engaged in producing equipment to hasten victory. With peace, we will resume the designing, developing and pioneering of equipment to provide better school room ventilation at less cost.

Herman Nelson Unit Ventilator

herman nelson

Sales and Service Offices in Principal Cities

The Herman Nelson Corporation MOLINE ILLINOIS

Autovent Fan & Blower Division, Chicago, Illinois

Manufacturers of

QUALITY HEATING, VENTILATING AND AIR CONDITIONING PRODUCTS

WITH THE MANUFACTURERS

OWENS-CORNING FIBERGLAS CORP.

has added five directors to its board. The new directors, who were elected at a recent stockholders' meeting in New York, are J. P. Levis, W. P. Zimmerman, H. R. Winkle, Games Slayter, and Dr. E. C. Sullivan. Mr. Levis, president of Owens-Illinois Glass Company, has been acting in behalf of Harold Boeschenstein, president of Owens-Corning, during the latter's absence with the WPB in Washington. Mr. Zimmerman is Owens-Corning's vice-president in charge of manufacturing and sales, and Mr. Winkle is treasurer and comptroller of the company. Mr. Slayter is vice-president and director of research, while Dr. Sullivan is vice-chairman of the board of Corning Glass Works.

Announcement was made also of advancement by the board of directors of G. E. Gregory, formerly director of sales, to the newly created post of vice-president in charge of commercial development, in which position he will work closely with J. H. Thomas, general sales manager.

PENN ELECTRIC SWITCH CO.

has moved its special research department, known as the "St. Louis Laboratory," from St. Louis to the home plant in Goshen, Ind. Directly supervised by Ralph Penn, treasurer of the company, this department was founded in November, 1940, to conduct research and experimental work on specialized new products. The particular development work undertaken has been completed and thus the equipment and personnel were moved to Goshen where production on these new controls is already under way.

AIRTEMP DIVISION, CHRYSLER CORPORATION

Dayton, Ohio, announces that William R. Zuhlke, formerly executive engineer for American Radiator Co., has joined the division as staff engineer. Mr. Zuhlke will coordinate activities of the home office engineering staff and laboratory and will later study developments of heating markets with respect to the post war line of heating equipment.

Airtemp has appointed C. H. Carey as district manager in the Atlanta territory. Recently Mr. Carey was associated with Aviation Engineering Co. of Atlanta.

George H. Cash has joined Airtemp as district engineer. Following preliminary training at Dayton and Detroit, Mr. Cash will handle field engineering problems for the New England territory from headquarters in Boston.

KINETIC CHEMICALS, INC.

has begun a new plant addition, which will make possible a 55% increase in the productive capacity for "Freon-12" fluorine refrigerant now used also as the propellant in aerosol insecticides. The addition, authorized by WPB, will be built at Carney's Point, N. J., and the new capacity is scheduled to be ready by February 1, 1944. The demand for "Freon" has increased so that this latest and largest plant addition is announced even before a previously authorized increase in capacity has been completed.

PERSONALS AND PERSONNEL

JOHN G. SEILER

John G. Seiler

has been elected vice-president of Tube Turns, Louisville, Ky., manufacturers of Tube Turn welding fittings and flanges. Mr. Seiler will retain his duties as sales manager of the company.

DR. RAY B. CREPPS

who has been director of Purdue University's materials testing laboratory, joined Owens-Corning Fiberglas Corporation September 1 as director of the testing division of the company's research laboratories, located at Newark, Ohio. He will be in charge of a new testing laboratory to be completed this fall. Under the direction of Games Slayter, vice president in charge of research, Dr. Crepps will be responsible for all tests of Fiberglas materials, both in the developmental and finished product stages.

Dr. Crepps was graduated from Purdue University in 1916. After several years in the building construction field he joined the Purdue engineering faculty. As director of the university's materials testing laboratory he has been responsible for testing the performance and properties of many types of materials. Much of his work has been on behalf of nationally known manufacturing organizations in the steel, concrete and glass industries.

SIEGFRIED ROSENZWEIG

president, The Korfund Co., celebrated in August his 20th year of association with Korfund. Mr. Rosenzweig joined Korfund in August, 1923, as consulting engineer, vice-president and general manager. Elected to the offices of president and treasurer in 1928, his years of endeavor have been reflected in the growth of Korfund.

FRED M. YOUNG

has been appointed vice-president and member of the board of directors of Western Metals Specialty Mfg. Co.

Mr. Young has long been identified with the Young Radiator Company of Racine, Wisconsin, serving as its president and general manager. He will continue to devote the greater part of his time to Young Radiator Co.

THOMAS E. FAHY

former New England District Manager of H. A. Thrush & Co. has been transferred by that company to Washington, D. C.

Depend on

REFRIGERATION

Accurately Controlled

When American Industry put on its full head of steam and swung into 24-hour-a-day, seven-days-a-week War Production, machines became too hot to handle, or too hot to work efficiently . . . Actually had to shut down for cooling off. But Yankee ingenuity found an answer. REFRIGERATION was added . . . And that's one reason why America is out-producing every other nation in the world.

Designing and building precision Control Equipment for Refrigeration's new War-time duties is one of A-P's most gratifying tasks. Today the A-P Research Staff is looking farther ahead, into post-war markets, working with many manufacturers readying revolutionary new products that will carry tomorrow's progress in Refrigeration to new achievements. Perhaps we can help with YOUR plans!

AUTOMATIC PRODUCTS COMPANY

2462 North Thirty-Second Street
Milwaukee 10, Wisconsin

DEPENDABLE Refrigerant Valves — STOCKED and SOLD by JOBBERS EVERYWHERE

WILLIAM B. GRIESE

formerly plant manager of the Liquid Cooled Engine Division, Toledo, has been transferred to plant manager of the Spencer Heater Division of the Aviation Corporation at Williamsport, Pa. C. N. Tull, former plant manager and one of the oldest employees of that company, will continue to assist Mr. Griese in industrial relations matters.

William B. Griese

NEW CATALOGS

PLASTICS

Monsanto Chemical Company, Plastics Division, Springfield, Mass.

A standard size, four-color bulletin entitled "The Family of Monsanto Plastics A Guide for Product Designers," and listing in attractive and useful tables and drawings the types, properties, and applications of the company's various plastics.

FANS

Buffalo Forge Company
Buffalo, New York

Pocket sized booklet "Maintenance and Installation Data" on industrial fans in air conditioning in easy-to-read form and with instructive illustrations. Covers comprehensively important steps in installation and maintenance, including many points sometimes overlooked in the care of equipment. Should prove an effective reference guide for erection and maintenance men. It presents, from a practical angle, recommendations on such subjects as fan foundations, installation, bearings, rotors, drives, couplings, fan balancing, inspection, cleaning, repairing, painting, safety precaution.

Available upon request from the company, at 480 Broadway, Buffalo 4, N. Y.

PIPING

The Flori Pipe Company
St. Louis, Missouri

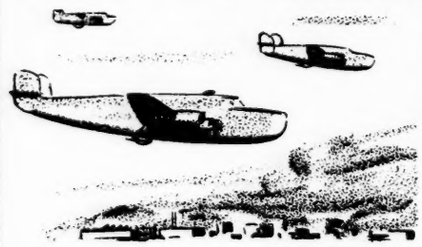
A 64-page, standard-size, varnish-cover, profusely-illustrated book covering the various ways in which piping can be used and listing market prices for every conceivable kind and size of fabricated piping. The book entitled, "If It's Piping Contact Flori," is available on request from Department K-2 of the company.

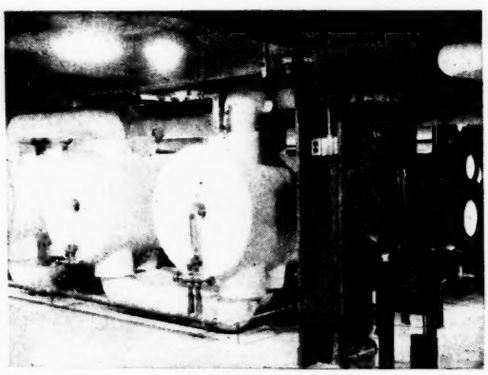
HEAT DIFFUSERS

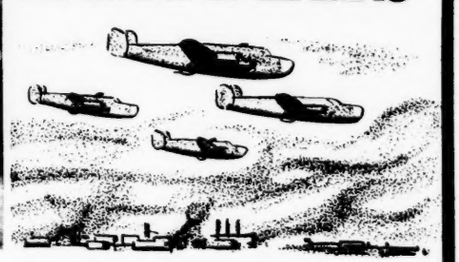
Carrier Corporation, Syracuse, N. Y.

Specification sheet describing blower-type heat diffusers. Four pages, standard size.

WHITLOCK HEATERS







are helping to "Hot up the Fire"

Prime Minister Churchill's suggestion for heating up the Axis requires a continued increase in America's production of planes.

We at WHITLOCK are proud to know that WHITLOCK Heaters and Heat Exchangers are aiding the efficiency of many well known aircraft companies such as Pratt & Whitney, Jacobs Aircraft & Engine Company, and North American Aviation, Inc. Hundreds of WHITLOCK Convertors, Service Water Heaters and Quenching Oil Coolers are giving dependable service in the Nation's war plants.

NOTE:—As you are probably aware, delays in purchasing heat exchangers are avoided by careful compliance with WPB regulations. The requirements for WPB approval are somewhat complicated but all WHITLOCK Engineers are familiar with the subject and will be pleased to advise you regarding the necessary procedure.

THE WHITLOCK MANUFACTURING COMPANY

40 South St., Elmwood, Hartford 1, Conn.

District Offices in NEW YORK, BOSTON, CHICAGO, PHILADELPHIA, DETROIT, RICHMOND

PIPING

The Oster Manufacturing Co.
E. 61st at Carnegie Ave., Cleveland, Ohio

Four heavy paper bound manuals covering the operation and maintenance of the company's portable and stationary pipe threading machines and giving information on spare parts for them. Each of the manuals is divided into three sections covering operation, maintenance, and spare parts. One manual covers the company's No. 422 power vise stand, another No. 502 "Pipe Master," the third No. 562 "Tom Thumb" and the fourth the No. 300 series pipe and bolt threading machines.

HEAT TRANSFER EQUIPMENT

Young Radiator Company
Racine, Wisconsin

Catalog No. 143, standard size, 8-pages, entitled "Young Heat Transfer Equipment for Every Application," summarizes the type of service and production the company is in a position to offer.

BUTTERFLY VALVES

R-S Products Corporation, Wayne Junction, Philadelphia, Pa.

A 4-page illustrated Bulletin 16-B, containing complete dimension tables for butterfly valves, 15 to 125 lb per sq in. Features valves for regulation and shut-off duty for air, gas, steam, liquids and semi-solids—manual and automatic control.

ARMY – NAVY AWARDS

Taylor Instrument Companies, Rochester 1, N. Y.

The Bristol Company, Waterbury, Conn.

Armstrong Cork Company, Lancaster, Pa.
(Addition of star to Army-Navy "E")

Penn Electric Switch Co., Goshen, Ind.
(Renewal)

Kewanee Boiler Corporation, Kewanee, Ill.
(White star addition to "E" award)

COMING EVENTS

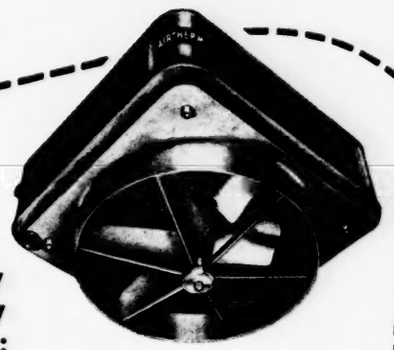
JAN. 31—FEB. 2—50th Annual Meeting of the American Society of Heating and Ventilating Engineers to be held at the Hotel Pennsylvania, New York, N. Y.

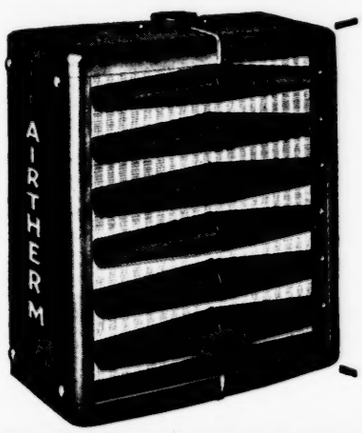
H&V's PHOTOS

Pages 72-73—Acme Newspictures, Inc.

AIRTHERM
UNIT HEATERS

FOR VERTICAL DELIVERY





FOR HORIZONTAL DELIVERY

Insist on These Quality Features When You Buy Heaters in War Times:

Extra-heavy tube-wall thickness of .065".
Ingot iron tubes.
Lead-alloy coated condensers for greatest possible protection from corrosion.
Condensers guaranteed to withstand steam pressure up to 150 lbs. per sq. in.

AIRTHERM
MANUFACTURING COMPANY
722 S. SPRING AVE. • ST. LOUIS, MO.